FRIDAY, APRIL 27, 1883.

NATIONAL ACADEMY OF SCIENCES.

THE annual meeting of this body was held in Washington during the last week, with an attendance of forty members. Scientific sessions were held on Tuesday, Wednesday, and Friday, in the large lecture-room of the National museum, and business sessions on every day of the meeting. A list of the papers read appears elsewhere in this issue.

Twenty-four foreign associates were elected, as follows, — *Astronomers:* Professor Otto von Struve of the imperial observatory at Pulkova, Russia; Prof. J. C. Adams of Cambridge, Eng.; Prof. A. Auwers, director of the observatory at Berlin; and Prof. Theo. von Oppolzer, director of the observatory at Vienna. *Mathematicians:* Professor Arthur Cayley of the university of Cambridge, Eng.; Prof. J. J. Sylvester of the Johns Hopkins university, Baltimore; and Prof. E. Bertrand of Paris. *Physicists:* Prof. R. Clausius of the university of Bonn; Baron H. von Helmholtz, professor in the university of Berlin; Professor Robert Kirchoff of the university of Berlin; Prof. G. G. Stokes of the university of Cambridge, Eng.; and Sir William Thomson, professor in the university of Glasgow. *Chemists:* Prof. J. B. Dumas, secretary of the academy of sciences, Paris; and Profs. M. Berthelot, Boussingault, Chevreul, and Würtz, all of Paris. *Geologist:* Freiherr von Richthofen, professor in the university of Bonn, and president of the German geographical society. *Botanists:* Sir J. D. Hooker, director of the botanical gardens at Kew, Eng.; Prof. A. de Candolle of Geneva. *Biologists:* L. Pasteur of Paris; Prof. T. H. Huxley of London; Prof. R. von Virchow of the university of Berlin; A. von Kölliker, professor of anatomy in the university of Würzburg. Professor Struve, one of the newly elected foreign associates, who is on a visit to this country, was a regular attendant at the scientific sessions of the academy, and read a paper.

In consequence of the death of Professor W. B. Rogers, the president, it became necessary to elect his successor. On the first ballot, Professor Wolcott Gibbs of Cambridge, one of the founders of the academy, was elected. He, however, firmly declined the honor, from a feeling, as he said, that he could not give the time necessary to the work. The academy reluctantly acquiesced in the decision of Professor Gibbs, and proceeded to a second ballot, when Professor O. C. Marsh of New Haven, the acting president, was elected by a handsome majority. The newly elected president will hold office for six years.

The first act of the new president was to announce that he had received from Mrs. Mary A. Draper, widow of Professor Henry Draper, the sum of six thousand dollars, accompanied by a deed of trust which fully specified the objects she had in view. He called upon Professor Barker to explain the nature of the trust to the academy. Professor Barker first made some appropriate remarks, recalling Professor Draper's interest in the academy, and then read the deed, the substance of which is as follows: the income of the trust is to be used "for the purpose of striking a gold medal, which shall be called the 'Henry Draper medal,' shall be of the value of two hundred dollars," and shall be awarded from time to time, but not oftener than once in two years, as a premium, to any person in the United States or elsewhere who shall make an original investigation in astronomical physics, the results of which shall be deemed by the academy of sufficient importance and benefit to science to merit such recognition. If at any time the income of the fund shall exceed the amount necessary for the striking of the medal, the surplus may be used in aid of investigations and work in astronomical physics, to be made and carried on by a citizen of the United States.

The president appointed Messrs. G. F. Barker, W. Gibbs, S. Newcomb, A. W. Wright, and C. A. Young, as a committee to have charge of the fund, to make rules to govern the award of the medal, and to suggest to the academy for approval the names of those who may be considered worthy of the award.

The treasurer announced, that, in accordance with the will of the late Professor James C.

Watson, the sum of about fourteen thousand dollars had been placed in his hands. When the estate is finally closed, a further sum will be paid over to the academy. The income of the Watson fund is to be used, under the direction of three trustees, — Messrs. J. E. Hilgard, S. Newcomb, and J. H. C. Coffin, — for the purpose of aiding astronomical researches. In accordance with the recommendation of the trustees, the academy granted five hundred dollars from this fund, towards defraying the expenses involved in observations of the total solar eclipse of May 6, 1883.

Later in the meeting, Professor Simon Newcomb of Washington was elected vice-president, and Professor Asaph Hall of Washington, home secretary. Five new members were elected: Professor A. Graham Bell of Washington; Dr. J. S. Billings, U.S.A., of the U.S. army medical museum, Washington; G. K. Gilbert, of the U. S. geological survey; H. B. Hill and C. L. Jackson, professors of chemistry in Harvard college. The whole number of members is now ninety-five.

On the afternoon of Thursday the academy adjourned to take part, by invitation, in the ceremonies attending the unveiling of the statue of Professor Henry in the grounds of the Smithsonian institution. The time for these ceremonies was purposely fixed to coincide with that of the spring meeting of the academy. Henry was pre-eminently a scientific man, and, at the time of his death, president of the academy; and yet the members of the academy were placed far down the line in the procession, — after the commissioners of the District of Columbia, and after officers of the army and navy. This fact must be regarded as evidence of a lack of appreciation of the relations existing between Henry and the academy, and of the true worth and dignity of science.

The exercises, which were in good taste, began with a short address by Chief-justice Waite. After this, at a signal, the covering was quickly drawn aside, instantly revealing the entire statue. Loud applause followed, those who were seated rose to their feet, and all hats were removed. The scene was highly impressive; and when the philharmonic society, accompanied by the full marine band, burst forth with Haydn's grand chorus, 'The heavens are telling,' the heart must have been a hardened one which did not experience a feeling of exaltation.

In the opinion of all, the statue is dignified and pleasing, and vividly calls to mind the honored original. President Porter's oration, which was the principal event of the afternoon, was listened to with much interest. It dealt with the plain facts of the life of Henry, and was all that his best friends could have desired.

Among the pleasantest social features of the meeting was a reception given to the members of the academy on Thursday evening by Prof. A. Graham Bell. There were present many well-known gentlemen, among them, Gen. Sherman, Chief-justice Waite, Senator Sherman, ex-Secretary Blaine, and the Japanese, Swedish, and Belgian ambassadors.

THE DECAY OF ROCKS GEOLOGICALLY CONSIDERED.[1]

THE author, in this paper, presented in a connected form the principal facts in the history of the decay both of crystalline silicated rocks, and of limestones or carbonated rocks, by atmospheric agencies. Having first discussed the chemistry of the process, he noticed the production of spheroidal masses, or so-called bowlders of decomposition, by the decay and exfoliation of massive rocks. He then proceeded to show that the process of decay is not, as some have supposed, a rapid or a local one, dependent on modern conditions of climate, but that, on the contrary, it is universal, and of great antiquity, going back into very early geological periods. These conclusions were supported by details of many observations among paleozoic stratified and eruptive rocks in the St. Lawrence valley, as well as among eozoic rocks in the Atlantic belt, as seen in Hoosac Mountain, in the South Mountain, and in the Blue Ridge. In connection with the latter he described the decay, not only of the crystalline strata, but of their enclosed masses of pyritous ores, and the attendant phenom-

[1] Abstract of a paper read by T. STERRY HUNT, LL.D., F.R.S., before the National academy of sciences at its meeting in Washington, April, 1883.

ena. The decay of the primal and auroral strata of the Appalachian valley, and the formation therein of clays and of iron and manganese oxides, was also discussed. The pre-Cambrian antiquity of the process of decay in the eozoic rocks of the Mississippi valley, as shown by Pumpelly and by Irving, as well as similar evidence from Europe, was noted, while the more recent decomposition seen in the auriferous gravels of California was described and explained.

The final removal of the covering of decayed rock from many northern regions during the drift period was then considered; and the thesis advanced by the speaker in 1873, that the decay of rocks "is an indispensable preliminary to glacial and erosive action, which removed previously softened materials," was discussed in its relations to bowlders, glacial drift, and the contour of glaciated regions. Pumpelly's development and extension of this doctrine to wind-erosion was noticed, and also the recent comparative studies of Reusch in Norway and in Corsica, in which similar views are enforced.

The principal points in the paper, as reviewed at its close, are as follows: —

1. The evidence afforded by recent geological studies in America and elsewhere, of the universality and the antiquity of the subaerial decay, both of crystalline silicated rocks and of calcareous rocks, and of its great extent in pre-Cambrian times.

2. The fact that the materials resulting from such decay are preserved *in situ*, in regions where they have been protected from denudation by overlying strata, alike of Cambrian and of more recent periods; or, in the absence of these, by the position of the decayed rock with reference to denuding agents, as in driftless regions, or in places sheltered from erosion, as within the St. Lawrence and Appalachian valleys.

3. That this process of decay, though continuous through later geological ages, has, under ordinary conditions, been insignificant in amount since the glacial period, for the reason that the time which has since elapsed is small when compared with previous periods; and also, probably, on account of changed atmospheric conditions in the later time.

4. That this process of decay has furnished the material, not only for the clays, sands, and iron oxides from the beginning of paleozoic time to the present, but also for the corresponding rocks of eozoic time, which have been formed from the older rocks by the more or less complete loss of protoxide bases. The bases thus separated from crystalline silicated rocks have been the source, directly or indirectly, of all limestones and carbonated rocks, and have, moreover, caused profound secular changes in the composition of the ocean's water. The decomposition of sulphuretted ores in the eozoic rocks has given rise to oxidized iron ores *in situ*, and to rich copper deposits in various geological periods.

5. That the rounded masses of crystalline rocks, left in the process of decay, constitute not only the bowlders of the drift, but, judging from analogy, the similar masses in conglomerates of various ages, going back to eozoic times; and that not only the forms of such detached masses, but the surface-outlines of eroded regions of crystalline rocks, were determined by the preceding process of subaerial decay of these rocks.

THE ORIGIN OF CROSS-VALLEYS.

I.

DR. FR. LÖWL of Prague contributes an interesting article on *Die Entstehung der Durchbruchsthäler* to a recent number of *Petermann's mittheilungen* (1882, 405–416), and comes to the conclusion that transverse valleys or water-gaps are never formed by the persevering action of an antecedent or pre-existing river on a slowly rising mountain fold or fault. "Erosion can, under no circumstances, keep pace with mountain folding" (409). Cross-valleys are then accounted for in two other ways, — first, occasionally by erosion at the outlet or point of overflow of the lake formed behind the rising mountain barrier; second, and so frequently as to constitute the general method, by backward erosion at the head of a lateral valley, which finally cuts through the ridge separating two longitudinal valleys, and allows the higher to drain across into the lower, so that in a folded mountain system of great age the original order of drainage on the longitudinal valleys is often entirely effaced (411). Several carefully examined cases of this kind are described for the eastern Alps and elsewhere. The question does not arise now whether these examples are correctly determined: presumably those to which sufficient local study was given are decided safely enough; for this backward origin of certain gorges is eminently possible. The question is rather, whether nearly all cross-valleys are of this ancestry, and whether the antecedent valley nowhere exists. We consider Löwl's affirmative answer to this question essentially incorrect, and believe that his

error of result comes from an error of method of but too prevalent a kind; namely, the assumption that things of a single geographic name are to be accounted for by a single physical or geological cause. Geographical nomenclature is in no condition to allow such an assumption; for no science has so loose, inaccurate, and insufficient a terminology as geography. Not a few examples could be given of errors arising from this *one-name, one-cause* idea. Until it is proved that two phenomena are closely alike in their several characters, an explanation of the origin of one will not necessarily apply to the other; and for this reason, in our present ignorance of the structure and form of many regions otherwise comparatively well known, it is not safe to extend local explanations over too broad a field.

Löwl rejects the possibility of a river's holding its course across a rising mountain fold; because the several examples discussed in his paper, chiefly those rivers on the northern slope of the Alps which are temporarily warped into lakes, have failed in doing so (408, 409). To this it might be answered, that these lakes are perhaps formed by a local depression of the valley-way, rather than by a local uplift at their outlets, and, moreover, that they constitute such an 'ephemeral phase in the river's history' as hardly to constitute a serious argument toward a decision. The temporary formation of a lake behind the growing fold, afterward drained by the victory of the river, is not sufficient ground for excluding the valley from the antecedent species, though it might serve for the marking of a variety. But even admitting the correctness of this conclusion for the Swiss rivers, it proves nothing for the rivers that escape from other mountain ranges. The success of the river depends on the proper relation of two variable factors, — the rate of its erosion, and the rate of the mountain's growth; and these may have such different relative values, — as determined by rainfall, drainage area, altitude, distance to the sea, mountain-making force, composition and attitude of the rocks, — that the predetermination of the result is impossible. Nothing short of close local study will serve to answer the question with any approach to certainty; and it therefore seems best to trust the Indian surveyors in their explanation of the Sutlej[1] gorge, and our own geologists in their reports on the rivers they have examined in the western territories. Concentrated erosion can keep pace with mountain folding, and antecedent valleys are often preserved.

Reference is made to the several transverse valleys of the Delaware, Potomac, and Susquehanna in the Appalachians (407), with the conclusion that they cannot be explained as antecedent valleys.[1] In spite of the many observers devoted to the study of the Appalachians in the past fifty years, there is yet no good topographic map of any large part of them, and much remains to be done in explaining their geological structure. It is still rather early to write their history; but we do not believe that the objections raised by Löwl to the antecedent character of their larger valleys are conclusive. The theory of these valleys, so far as it can be now stated, should, of course, be led by the facts so far as they are now known; and, in the writer's mind, the facts lead directly to the theory that the valleys are antecedent. The question is made clearer if we consider first the case of the rivers in Tennessee and south-western Virginia that rise in the archaean mountains of North Carolina, — the Great Kanawha and the Tennessee. The first of these follows the direction of slope that must have prevailed through all paleozoic time, in running from the old crystalline mountains, north-westerly, across the strata derived from their waste. We must conclude that the growth of the great post-carboniferous folds and faults on its course were insufficient to turn it into a north-eastward or south-westward channel. It flows along a true antecedent valley; and our notions of the rates of mountain growth and river erosion should conform to the fact of its existence. The Tennessee also finally makes its way to the north-west; but none of its branches that rise in the North Carolina mountains succeeded in crossing all the folds and faults that grew in front of them. Although they all made their way through some of these barriers, they were sometimes turned to the south-west; and not until they were united in great volume could they escape to the north-west at Chattanooga, and again at Claysville, Ala. This shows a river greatly embarrassed by the difficulties that arose in its way. Most of its branches failed, and were turned aside into consequent longitudinal valleys; but some suc-

[1] Hardly recognizable in its modern Germanized form, *Satladsch*. The German transliteration of the valuable English consonant, j, is very cumbersome. Witness *Udschidschi*.

[1] Löwl does not detect a misquotation by Tietze, whose valuable *Bemerkungen über die bildung von querthälern* (*Jahrb. geol. reichsanst.* 1878, 581-610) he endeavors to controvert. Tietze states (600), that, according to Dana, the Appalachians grew by addition of parallel folds on the eastern or seaward side. Löwl quotes Credner to prove the opposite order of growth, but Dana also said just the reverse. See *Amer. journ. sc.*, iii. 1847, 183.

ceeded, and these survive in the existent water-gaps. There can be little doubt that lakes very frequently appeared and disappeared on these stream-courses during the growth of the mountains.

THE INTELLIGENCE OF FISH.

IN Mr. Romanes's recent volume on Animal intelligence,[1] only thirteen pages are devoted to the intelligence of fish. That this class of animals is more 'knowing' than is generally believed, is, I hold, unquestionable. From frequent conversations with old fishermen, I have learned that the exercise of cunning, on the part of fish, is by no means uncommon; and I have also found that certain sayings are common among these people, such as 'cute as an eel,' 'sly as a snippick,' i.e., snipe-pike (Belone truncata), which also show that fish are credited with considerable intelligence by these practical observers, whether rightfully or not. My own impression, based upon long-continued, careful study of our fish, long since fully convinced me that many of them were possessed of nearly as much intelligence as birds, and more than either the snakes or batrachians. This may seem a hasty statement, but I believe it is substantially correct. For this reason, I am surprised that so little has been recorded by observers, with reference to fish, as is evident from the meagre array of facts presented by Mr. Romanes in the work mentioned. The author, in the opening remarks of his chapter on fish, says, "Neither in its instincts nor in general intelligence can any fish be compared with an ant or a bee." This statement I propose to dispute, because there is abundant evidence that the intelligence of fish varies exceedingly, and some fish do possess an amount of cunning which brings them nearer to the ants or bees than Mr. Romanes's remark would imply. Had our author said 'most fish,' perhaps no exception could have been taken to the statement; but, using the words 'any fish,' he is, I think, open to criticism.

But what are the evidences that some fish possess such an amount of intelligence as I have intimated? In reply, I have to offer a case of great cunning shown by a number of pike when in danger of capture. A gilling-net had been placed across the outlet of a small tributary of Popihacka Creek. In this little spring-brook several large pike had wandered in search of minnows. Being disturbed, they rushed with great impetuosity towards the net, and the foremost of them was at once securely entangled in its meshes. Straightway the others stopped as suddenly as they had started, and, recognizing their fellow in trouble, 'took in the situation' at once. Each pike evidently realized the true condition of affairs, and reasoned thus: that pike tried to go through this obstacle in the water, and is in trouble; it is necessary for me to avoid it by some other means. There were five of these fish that paused close to the net; and each acted, I believe, as it *thought* best. One of them came to the surface, and, after a moment's pause, turned upon one side, and leaped over the cork-line. Seeing the success of this effort on the part of one, a second did the same. A third came to the shore near where I stood, and, discovering a narrow space between the brail and the net, passed very slowly through, as though feeling its way, although the water was so shallow that its body was fully one-third out of the water as it did so. The others were either more timid or less cunning. They turned to go up stream; but being met by my companion, who was making a great noise by whipping the water, they rushed again towards the net, but checked their course when their noses touched the fatal net. Prompt action was necessary. They had not confidence in their leaping-powers; and both, as though struck with the same thought at the same moment, sank suddenly to the bottom of the stream, and burrowed into the sand and beneath the lead line, which was in full view. In a moment they reappeared on the other side of the net, and were gone. I could have prevented the escape of all of these fish, but was so much interested in the evidence of thought exhibited by them, that the idea of molesting them did not occur to me. There was something in the manner of these fish, too, which is not readily described, but which gave an importance to those acts, on their parts, that I have mentioned, and which added materially to the strength of the evidence that they were 'thinking' in all that they did.

Evidence of the intelligence of fish is further shown by our common sunfish (Eupomotis aureus), which not only mates early in the spring, and guards its nest and young until the latter are able to shift for themselves, but in many cases remains paired. If it can be said of storks, that marriage occurs among them, the same is true of sunfish. I have known the same pair to occupy for several years the well-protected space bounded by the twisted roots of an enormous maple, that

[1] Animal intelligence. By George J. Romanes. — (*Internat. sc. ser.*, no. xliv.) New York, *Appleton & Co.*

projected into the water. In this case, and I know of many others, these fish plainly showed the existence of strong mutual affection. Indeed, when once the nest is formed, a pair of young sunfish, mated but for the single season, are evidently very fond of each other; and, if one of them is caught, the other is straightway stricken with grief, which it shows by unmistakable signs. Grief is, of necessity, a true mental operation. It cannot be referred to instinct, as defined by Mr. Romanes; and that sunfish are grief-stricken when deprived of their mates is unquestionable. It is only necessary to take one from the nest, and let it nearly die by exposure to the atmosphere; then replace it, and watch the actions of the other. No one will, I think, hesitate to consider as grief the emotion that controls the fish thus deprived of its mate.

The common catfish (Amiurus catus) likewise exhibits great affection for its young, which remain with the parent-fish for several weeks after they are hatched. She does not, indeed, always succeed in keeping her brood together; but, so long as she does, she will defend them from all enemies, without regard to her own safety. I once placed a glass globe containing a brood of young catfish on the bank of the stream from which they were taken, and in full view of the parent-fish, which was greatly excited by being deprived of her charge. This fish at once recognized that her young were not in the creek, although they were swimming in water. After a variety of restless movements, its curiosity overcame its discretion; and it left the creek, and, as best it could, made its way to the base of the globe containing her young, a distance of about two feet. Here she remained for nine minutes, quietly watching her brood, and then returned to the water. In a few moments she returned, having recovered from the effects of exposure to the air. I now liberated the young catfish; and they immediately clustered about their parent, and followed her into deep water. In this case the parent-fish made no effort to escape when I approached, and allowed me to handle her without any resistance. I have since tried similar experiments with these fish, and always with essentially the same results.

Instances, also, might be multiplied indefinitely of actions, on the part of fish, indicative of cunning or forethought, — cunning in their efforts to secure their prey, forethought in their efforts to escape their enemies. I have even seen ingenuity exercised by a roach, notoriously the most stupid of fish. Space, however, will not permit of further details. Let it suffice to mention, that the actions of predatory fish in hunting in schools, and those of comparatively helpless fish (such as the cyprinoids) in keeping together in large companies, that collectively they may lessen individual danger, are cases that exhibit evidence of a realization of the fact that in union there is strength. The predatory fish know, that, by concerted action, their prey can be more readily captured. Those that are exposed to attack know, that, as one in a thousand, the chances of each of escaping its foes are greater than if it wandered solitary and alone.

The very fact that our fish vary greatly in their habits is, of itself, evidence that they differ in their intellectual capacities; those that are solitary being the quicker witted, and the more prompt to adopt some ingenious device to meet the requirements of the moment. Witness, in this regard, the pike, the black bass, the etheostomoids, the mud-minnow (Umbra). In these we have instances of fish that clearly demonstrate the possession of a considerable range of intelligence. On the other hand, watch the distracted schools of cyprinoids chased by rock-fish or perch. It is seldom that they do more than trust to luck; and these fish are never seen except associated in large numbers.

Nor must the fact that many fish, as the mud-sunfish (Acantharcus pomotis), eel, catfish, and chub-sucker (Erymizon sucetta), have well-defined vocal powers be overlooked; for it, too, has a bearing on the subject of the intelligence of fishes, in that the circumstances under which these vocal powers are exercised are such as indicate that they are intended to convey ideas to others of their kind, — an act which necessitates a complicated mental effort.

After years of familiarity with the many species of fish found in the Delaware River and its tributaries, I find that they can only be intelligibly described by using such terms as 'cunning,' 'fear,' 'grief,' 'ingenuity,' and 'anger;' and if their actions unquestionably indicate the possession of such emotions and faculties, — and I claim that they do, — then the great gulf, mentioned by Mr. Romanes, between the intelligence of fish and that of ants and bees, is materially lessened; and future studies of the much-neglected subject of the habits of fish will, I believe, ultimately show that many fish are the intellectual equals of any existing insects.

Chas. C. Abbott, M.D.

ACTIVE JAPANESE VOLCANOES.[1]

THE following list of Japanese volcanoes contains only those which are either active now, or of which records of eruptions exist, or which have evidently been active in recent times, as shown by their solfataras. The number of extinct cones is not known: especially is this the case in Yesso.

The number of known volcanoes in the Kurile Islands is 52 (of these, 12 are active); in Yesso and adjacent islands 19 (active 12); in Hondo, Kiushiu, and adjacent islands, 60 (active 24). In all there are 131, of which 48 are active. These figures are somewhat different from those ordinarily stated. The latitudes given do not claim any great accuracy, but are put in to give an approximate idea of the positions: they are taken from the best Japanese maps. The names Yama, San, Take, Nobori, are synonymes of mountain.

The active volcanoes are most numerous between 138° and 140° E. long. and the parallels 32° and 38°. It is therefore not strange that Tokio, situated within these limits, should have experienced 377 earthquake-shocks in the five years from 1876 to 1881. Dr. C. GOTTSCHE.

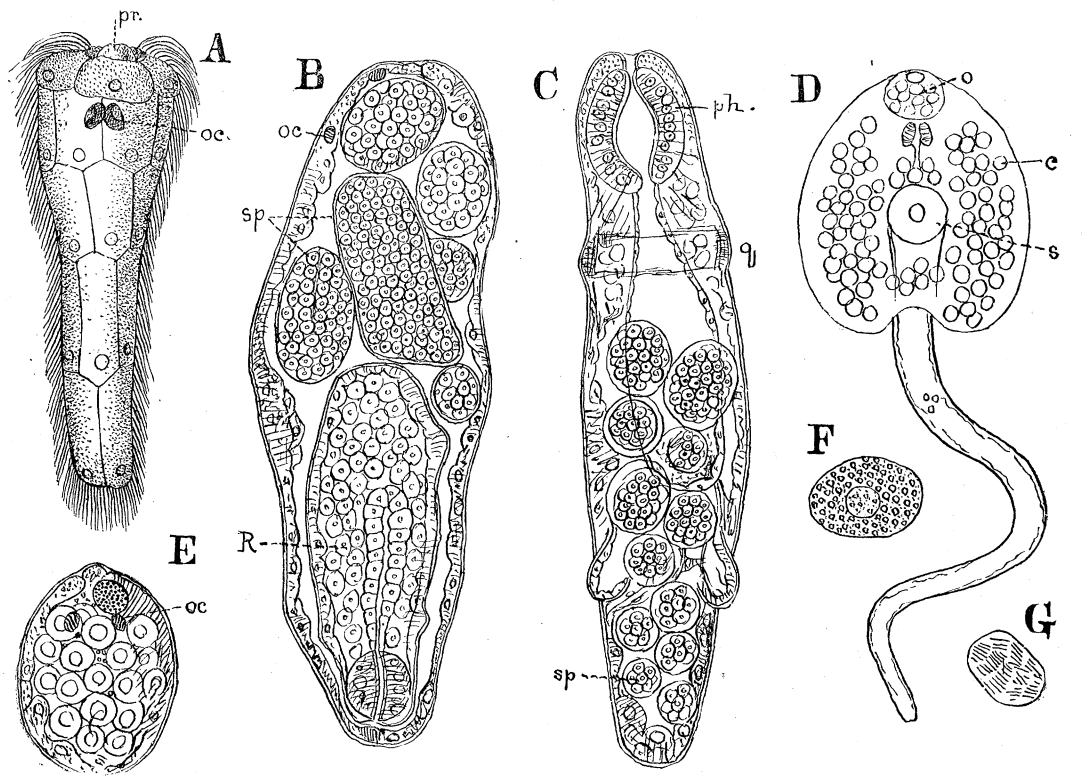
LIST OF JAPANESE VOLCANOES IN ACTIVITY.

No.	North lat.	Name.	A number here refers to date of last eruption.	Corresponding names of other authors.
		a. Kurile Islands.		
1	50° 54′	Alaid.	1793.	
2	50° 45′	Mount Ebeko, on Poromushir.	Smoking in 1877.	
3	50° 15′	Fusspeak, on Poromushir.	1793.	
4	48° 53′	Mount Simnarka, on Shiaskotan.	1855.	
5	48° 16′	Raikoku.	? 1780.	
6	48° 6′	Sarytschew, on Matua.		
7	46° 29′	Chirnoi.		
8	46°	Urup.	Smoking, according to Krusenstern, Langsdorf, Lütke.	
9	45° 30′	Moshisinayama, on Iturup.		
10	45° 20′	Rebunshirinobori, on Iturup.		
11	44° 30′	Chachatake, on Kunashir.		
12	44° 3′	Loussoyama, on Kunashir.		
		b. Yesso and adjacent islands.		
13	44°	Itashibeoni.	Solfatara.	Iwaosan.
14	43° 20′	Meakan.	Solfat.	
15	43° 3′	Yoichitake.	Smoking in 1878.	Yatsunai.
16	42° 55′	Iwanainobori.	Solfat.	Iwaosan, Iwaotake, Iwaonobori.
17	42° 40′	Tarumaitake.	1874.	Aiyama.
18	42° 40′	Usutake.	Solfat.	
19	42° 35′	Nuburibetsutake.	Solfat.	
20	42° 5′	Komagatake.	1856.	Sawaratake.
21	41° 50′	Esanyama.	Solfat.	Uchiura.
22	45° 11′	Riishiri.	Solfat.	Pic de l'Angle.
23	41° 31′	Oshima.	Smoking.	
24	41° 21′	Koshima.	Smoking.	
		c. Mainland (Hondo).		
25	41° 20′	Yakeyama.	Active within historical time, according to Japanese authors.	Osorisan.
26	40° 37′	Iwakiyama.		Tsugaru-no-fuji, Pic Tilesius.
27	39° 7′	Chokaisan.		
28	39° 50′	Ganjusan.	Solfat.	Iwateyama, Iwawasiyama.
29	37° 7′	Nazuyama.	Solfat.	
30	36° 50′	Shiraneyama, near Nikko.	1873.	
31	36° 40′	Shiranesan, near Kusatsu.	1882.	Kusatsuyama.
32	36° 35′	Tateyama.	Solfat.	
33	36° 22′	Asamayama.	1867.	
34	36° 8′	Hakusan.	? 1554.	Shirayama, Koshi-no-Shirayama.
35	35° 21′	Fujisan.	1708.	Fuji-no-yama, Fusiyama.
36	35° 16′	Hakoneyama.	Solfat.	
		d. Islands south of Hondo.		
37	34° 42′	Miharayama, on Oshima.	Active.	(Oshima = Vries Island.)
38	34° 15′	Kodzushima.	Within historical time.	Kamidzu.
39	34° 7′	Otokoyama, on Miyakeshima.	1874.	Nanahiroyama.
40	33° 7′	Hachijo.	? 16th century.	Fatsitzio.
41	32° 34′	Aogashima.	Within historical time.	
		e. Kiushiu, and islands south-west of Kiushiu.		
42	32° 45′	Asoyama.	1874.	
43	32° 44′	Unzengatake.	1793.	
44	31° 45′	Kirishimayama.	Solfat.	
45	31° 33′	Mitake, on Sakurajima.	1828.	
46	30° 45′	Iwoshima.	Active.	Iwogashima.
47	29° 39′	Suwaseshima.	Solfat.	Suwashima.
48	27° 51′	Torishima.	Solfat.	Iwoshima.

[1] Extract from a letter dated Tokio, Jan. 12, 1883, communicated by Professor Jules Marcou.

LIFE-HISTORY OF THE LIVER-FLUKE.

PROF. A. P. THOMAS, now of Auckland, New Zealand, has published in full the results of his valuable and important researches on the development of the liver-parasites, which produce the so-called 'rot,' —a disease that is especially fatal to sheep, but sometimes occurs in man. It is estimated to have occasioned the loss of some 3,000,000 sheep in Great Britain during the winter of 1879–80. Leuckart has also studied this subject, and reported his observations in the *Zoologischen anzeiger* for Oct. 9, 1882. Thomas's results, as given in the *Quarterly journal of microscopical science* for January, 1883, are remarkably complete; and, as they are of general interest, we present an abstract of them.



EXPLANATION OF FIGURES. — A, embryo; B, sporocyst; C, redia; D, cercaria; E, young sporocyst; F, cystogenous cell; G, pod cell from cercaria. *oc*, ocelli; *sp*, spores; *R*, redia; *ph*, pharynx; *q*, collar of redia; *c*, cystogenous cells; *s*, sucker.

The adult worm (Distomum hepaticum) infests the liver of mammals. It discharges its eggs into the bile-ducts, which they sometimes clog. The eggs then pass into the intestines, and may be found abundantly in the droppings of the host. The number of eggs emitted by a single fluke may be safely estimated at several hundred thousands. Segmentation of the ovum occurs in the body of the host; but the further development being dependent on a lower temperature than that of the mammalian body, and on moisture, can proceed only after the eggs are discharged. 23°–26° C. is most favorable, the embryo being formed in about three weeks. At a lower temperature, the development is prolonged; but, under the same conditions, the individual eggs vary enormously as to the time needed to produce the embryos: hence a field once infested remains dangerous for a long time. The embryo enlarges at the expense of the nutritive material (so-called *yolk-cells*, though they have nothing to do with the yolk), and, when mature, bursts open the operculum of the egg-shell, and immediately begins swimming freely in the water. Its form is an elongated cone (0.13 mm. long), with rounded apex, as is shown in fig. A of the accompanying cut. The base of the cone is directed forwards, and in its centre is a short retractile head-papilla, *pr*. The whole surface is covered with cilia, which are borne by the large ectodermal cells. In the interior are *two* eyes, *oc*, and other structures, which are very briefly described, and call for further study. The embryo is exceedingly active, swimming about like an infusorian, though more rapidly. When it meets a Lymnaeus trunculatus (a common snail), its first host, it presses the head-papilla against the surface of the snail, and begins spinning around its axis, and working its body, until the tissues of the snail are forced apart, leaving a gap through which the embryo squeezes its way into its host. The embryo appears to have some means of instinctively recognizing the trunculatus, for it does not attack other species. It cannot live much more than about twelve hours in water, and it usually gets into a snail within eight hours.

In the snail it changes into a sporocyst, which, during warm summer weather, may reach its full size within a fortnight; but in autumn twice that time

may be necessary. The outer ciliated cells swell up, and are finally cast off. The embryo then becomes an elliptical cyst, the pigmented eye-spots being still preserved, fig. E. The cyst grows and elongates. The body is then covered by an external cuticle, under which is a sparse musculature, followed by an epithelium, which lines the cavity, and forms the greater part of the thickness of the body-walls. The author gives some further structural details. Sometimes, but less frequently than in other species, these sporocysts multiply by transverse division, effected by a gradually deepening constriction about the middle of the body.

The next larval forms, the rediae, are developed within the sporocyst. The cells, which each give rise to a redia, are in part soon present in the embryo; but they increase later by proliferation of the cells lining the cavity of the sporocyst. The first clearly recognized appearance of the rediae is as a morula-like cluster of cells, which soon assumes the gastrula form. An external membrane appears, and, later, a pharynx. There are several germs in each cyst, usually one redia (less frequently two) nearly ready to leave the sporocyst, with two or three germs of medium size, and several small ones, fig. B. When ready to leave the cyst, the redia, by its own motions, makes a forcible exit by rupturing the walls of the sporocyst. The free rediae force their way through the tissues of the host, and are found especially in the liver. They increase in length to 1.3 mm. or 1.6 mm., fig. C; a collar, *q*, being formed, meanwhile, a little behind the pharynx. In other respects, except the possession of a digestive tract, the rediae resemble the sporocysts in structure. They are, however, more muscular, and present other differences, which the author describes. There is present a distinct birth-opening at the side of the body, a little behind the collar, which permits the exit of the brood from within the redia. The germs, *sp*, develop similarly to those of the sporocysts, but are more numerous. Sometimes they form rediae, and sometimes cercariae; yet the early stages of the spores are the same in either case. A germinal cell, forming part of the internal lining of the posterior end of the body-segments, forms a morula. A gastrula enlarges, and gradually assumes a shape that reveals whether it shall become another redia, or a cercaria. There may be as many as twenty-three spores in various stages of development in one redia. It is probably the temperature which determines whether rediae or cercariae are produced; since the former are produced during the warm, the latter during the cold months.

The development of the cercariae, the next form in the series, takes place, as we have seen, in the redia. As the oval enterate spore increases in size, it assumes a more elongated shape; whilst one end becomes more attenuated than the other, and finally is constricted off to form the tail. The thicker portion becomes the body proper, and in it are developed the bifurcate intestine and other organs. Certain cells, F, later develop into the organs for secreting the cyst; and many of the cells in the body of the cercaria are crowded with most remarkable rod-shaped bodies, G, closely resembling bacteria in size and shape, reaching a length of 0.006 mm. In an adult redia, with a brood of twenty or so, there will be one, two, or three cercariae approaching complete development.

As soon as the cercaria has reached the limit of development within the redia, it escapes from the parent by the birth-opening. When free, D, the cercaria is very active, and constantly changes its form. Its most striking characteristic is the presence of the cystogenous cells, D, *c*, before mentioned. These are large, and so crowded with coarse, highly refractile granules as to be rendered quite opaque, F. They are arranged in two-lobed masses, extending along each side of the body, and connected together just in front of the ventral sucker.

By the aid of its suckers, *o* and *s*, and tail, the tadpole-shaped cercaria crawls or wriggles its way out of its host. When the infested snails are kept in an aquarium, the cercariae may occasionally be found swimming about in the water, but not long; for, on coming in contact with the side of the aquarium or the water-plants, it proceeds to encyst itself. The process can be readily observed under the microscope; for, on a glass slide, the cercaria soon comes to rest. It assumes a rounded form; whilst a mucous substance is poured forth all over the body, together with the granules of the cystogenous cells. The tail is shaken off either before or during encystation, which is completed in a few minutes. These cysts are the means of infecting the final vertebrate host of the parasites; the infection being rendered possible by the habits of the intermediate host, Limnaeus truncatulus, which might well be termed amphibious, so strongly is its habit of wandering on land developed. Indeed, they can remain on land for long periods, and resist even prolonged droughts: hence, when in the water, the snails become infested, and, when on land, leave the cercariae that crawl out of their first host scattered over the fields, where they encyst on the grass, and are eaten by the sheep and other animals.

In the stomach the cyst is dissolved, leaving the worm free. The worm then makes its way into the liver, and probably in about six weeks begins to produce eggs, growing meanwhile. During its growth its external form changes, the simple forked intestine develops many coeca, the posterior sucker is greatly enlarged, and the sexual organs are matured. Thereafter, the wondrous cycle of metamorphoses and emigration recommences with the new eggs. There are, perhaps, no other instances more striking, of the adaptation of animal species to particular conditions of existence, than we find in histories of such parasites as the trematode worms, of which we have narrated one life-history. Charles S. Minot.

FLUORINE MINERALS.

P. Groth has carefully reviewed (*Zeitschr. kryst.*, vii. 457) the following minerals, mostly from Greenland: —

Pachnolite. — This is shown to be entirely distinct from thomsenolite. The pure crystals were submitted to J. Brandl for analysis, who found that they corresponded closely to the formula $NaF . CaF_2 . AlF_3$. It is distinguished from thomsenolite by its absence of water, and has arisen from the analogous mineral cryolite by the substitution of a calcium atom for two atoms of sodium. Heated in the closed tube, the mineral decrepitates violently, covering the sides of the tube with a white powder. The crystals are monoclinic. Almost all show the form of slender prisms, the largest from 2 to 3 mm. long, and 0.5 mm. thick, terminated at one end by an apparently rhombic pyramid, and at the other by two basal planes making a very obtuse angle with one another, showing the twin nature of the crystals. The twinning plane is parallel to the ortho-pinacoid; and the two halves are so equally developed that the two hemi-pyramids appear above like a very perfect rhombic pyramid. The prismatic faces are finely striated in

a horizontal direction. The axial relation $a : b : c = 1.1626 : 1 : 1.5320$. $\beta = 89° 40'$.

Thomsenolite. — This mineral occurs in far greater quantity than pachnolite. Its chemical composition, from analysis by J. Brandl, is $NaF . CaF_2 . AlF_3 . H_2O$. Heated in the closed tube, it decrepitates violently, giving off acid water. The axial relation $a : b : c = .9959 : 1 : 1.0887$. $\beta = 89° 37\frac{1}{2}'$. Besides the perfect basal cleavage with mother-of-pearl lustre, a second cleavage parallel to the prism was observed. The habit of the crystals is prismatic, the prism striated horizontally.

Ralstonite. — This mineral occurs crystallized in isometric octahedrons; and thus far its constituents have been determined by a qualitative analysis made on a very small quantity, and one imperfect analysis, showing it to be a fluoride of aluminium, magnesium, calcium, and sodium, with water. Carefully selected material, submitted to analysis by J. Brandl, gave the following: F (57.12) . Al (22.14) . Na (5.50) . Ca (1.53) . Mg (3.56) . H_2O (10) = 99.85, corresponding to the formula, $3 (Na_2MgCa) F_2 . 8 AlF_3 . 6 H_2O$. The mineral occurs intimately associated with the thomsenolite.

Chiolite. — This is a tetragonal mineral, resembling cryolite, occurring in the Ilmen Mountains, with axial relation $a : c = 1 : 1.0418$. It seldom occurs in well-developed crystals; and, when so, the crystals are small. Occasionally it is met with in snow-white clusters composed of an aggregate of minute crystals. The various older analyses of the mineral vary very considerably; and a new analysis, by J. Brandl, gives the following result: F (57.30) . Al (17.66) . Na (24.97) = 99.93, corresponding to the formula, $5 NaF . 3 AlF_3$.

Arksutite. — This mineral, which has for a long time been regarded as a distinct species, is shown to be based upon an incorrect analysis, and is probably nothing more than a mixture of cryolite with pachnolite.

Fluellite. — This mineral, which is one of the rarest, is known in the form of minute sharp rhombic pyramids, occurring with wavellite and other minerals from Cornwall. With great trouble .12 gram was obtained quite pure for analysis. This gave J. Brandl the following: F (56.25) . Al (27.62) . Na (0.56) [H_2O (15.55)] = 100. This agrees closely with the simple formula, $AlF_3 . H_2O$.

Prosopit. — This rare mineral, found at Altenberg, Saxony, but not since 1866, occurs mostly altered into kaolin, in some cases the crystals having a core of unaltered material within them, while a few are wholly unaltered. The crystals, while they have been converted into kaolin, have retained their form most perfectly. The crystals are monoclinic, with the axial relation $a : b : c = 1.318 : 1 : 0.5912$. $\beta = 86° 2'$. Pure material gave J. Brandl, upon analysis, F (35.01) . Al (23.37) . Ca (16.19) . Mg (0.11) . Na (0.33) . H_2O (12.41) . loss regarded as oxygen (12.58) = 100, corresponding to the formula, $CaAl_2 (F, OH)_8$, in which fluorine and hydroxyl are isomorphous.

S. L. Penfield.

COLOR AND ASSIMILATION.

A new method of measuring the effect of rays of different degrees of refrangibility upon the assimilative activity of vegetable cells has been recently devised by Th. W. Engelmann of Utrecht. It will be seen that the method is simple, and probably of wide applicability. It consists in the use of a few uninjured cells, — for instance, of some filamentous alga, — placed in water which contains bacteria. If oxygen is evolved from the cells, as in assimilation, the bacteria, which up to that time may have been quiescent, become extremely active, and the activity is greatest close to the assimilating cells. If light be now withdrawn, the supply of oxygen is soon exhausted, and the bacteria again become quiet, resuming their activity as soon as the slightest trace of free oxygen is accessible to them. By their presence it is possible to detect, according to Engelmann, the one trillionth of a milligram of oxygen.

Supposing a long filament of some alga is thus arranged under the microscope, and light passes through the slide, the character of the light is seen at once to have a very marked effect upon the movements of the bacteria. If the light has first been passed through a direct-vision spectroscope placed *under* the stage of the microscope, so that the filament lies in the length of the spectrum thus produced, the bacteria are seen to cluster immediately in certain parts of the spectrum, to the exclusion of the others; and the inference is not unfairly drawn, that they go where oxygen is most abundant. To the facts thus presented in an earlier paper, Engelmann adds, in the *Botanische zeitung* (Jan. 5 and 12, 1883), some curious observations regarding the assimilative power possessed by vegetable cells of different colors. In brief, his results are the following: only those cells which contain chlorophyll or its equivalent in the protoplasmic body have any power of evolving oxygen; a colorless cell, or one which has coloring-matter only in the cell-sap, cannot evolve oxygen under the influence of any rays of light. This has a direct bearing upon the so-called 'screen' theory of Pringsheim, according to which the pigment acts only as a screen to diminish the otherwise too intense effect of light. It may be stated that Pringsheim suggested, that, by passing through a thin layer of solution of chlorophyll-pigment, the light would be so tempered as to bring about assimilation in colorless protoplasm. Engelmann shows that this is not likely to happen under any conditions of screening.

Furthermore, in experimenting upon algae of different colors, he found that the assimilative activity is not in the same part of the spectrum for all cells. For instance: the greatest activity for red cells is in the green; for green cells, in the red; for bluish green, in the yellow; and, for yellowish brown, in the green and red; or, *in general, in the color that is almost or completely complementary to the color of the cell.* To state this in another form, it may be said that the rays of the spectrum which effect the work of assimilation are identical with those which are absorbed by the chlorophylline coloring-matter.

It may be added that a large number of Engelmann's experiments were made by the use of Edison's lamp. In *Pflüger's archiv* for Jan. 10, the same author has a paper on a bacterium which he has found to be extremely sensitive to light, and which has been named B. photometricum. There are a few points in that communication which are not wholly in harmony with the facts stated above; but, as they are of minor consequence, they may be passed over now without further mention. Geo. L. Goodale.

LARVAL STAGES AND HABITS OF THE BEE-FLY HIRMONEURA.

Nothing is yet known of the first larval stage of the bee-flies. I have expressed the belief that future observation would show that there is a parallel between the Meloids and the Bombyliids, in that the first or newly-hatched larva of the latter would differ from the clumsy, partially parasitic, full-grown larva,

by being more active, and somewhat different in structure (*Rep. U. S. ent. comm.*, ii. 267). Mr. Adam Handlirsch of Vienna has recently published[1] a most interesting account of the life-history of the European Hirmoneura obscura Meigen, which tends to confirm this opinion. Hirmoneura is the only genus we have in the United States belonging to the Nemestrinidae, — a family so closely allied to the Bombyliidae, that Mr. Handlirsch's observations are of especial interest in this connection. I condense from it the following facts, and borrow the chief figures illustrating them.

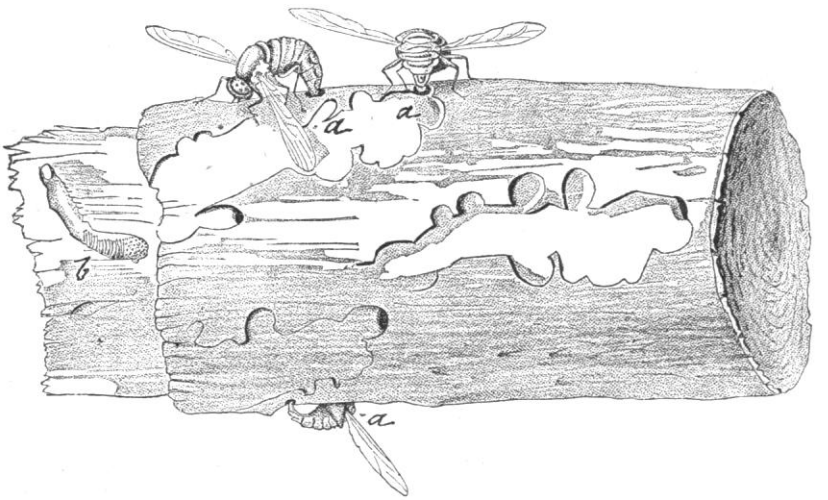


FIG. 1. — *a*, *a*, *a*, females ovipositing in burrows of Anthaxia; *b*, eggs at bottom of burrow. Natural size. (After Brauer.)

Herr Handlirsch first succeeded, in July, in observing the act of oviposition; the female fly inserting her ovipositor deeply into the old burrows of small wood-boring insects (probably Anthaxia) in a pine fence surrounding a pasture. The eggs, laid in clusters, were actually found within these burrows. Upon investigation, however, it was found that the fence-rails did not contain galleries sufficiently large to have been made by the Hirmoneura larvae; but hundreds of its pupae and pupa skins were discovered in the pasture, protruding from the ground, and mostly held upright by their terminal hooks. Male and female flies were also observed issuing from these pupae; while, in the ground under the pupae, the exuviae of the full-grown Hirmoneura larvae were, in every instance, found at a depth of about one-half decimetre. Still deeper were found the remains of the pupa of a large-sized lamellicorn beetle, which proved to be the common Rhizotragus solstitialis. In one instance Mr. Handlirsch also found the full-grown Hirmoneura larva just issuing from the abdomen of the Rhizotragus pupa. Finally he succeeded in following up the early history of the young larvae. They issued in great numbers from the aforementioned burrows in the pine fence, and, placing themselves in an upright position at the entrance of the burrows, allowed themselves to be blown away by the wind. They have so far not been followed from this point to full growth as a parasite on the pupa of the Rhizotragus; and some interesting facts yet remain to be discovered. The newly-hatched larvae can live a long time without food, as one of them, hatched on Aug. 17, was kept in confinement until Oct. 29.

But the most interesting point in connection with these discoveries is the structure of the young larvae. It is unnecessary to enter into the descriptive details given by Mr. Handlirsch. I merely wish to point out, that the young Hirmoneura larva is distinguished from the full-grown larva by its slender form, somewhat different structure of the mouth-parts, but principally by the presence of ventral pseudopods bearing long and hooked setae. Joints 6–12 are each provided with one pair of these pseudopods, bearing a stout seta hooked at tip, with the hook pointing backward; while the thirteenth joint bears two pairs of similar setae, but with the hooks directed forward, thus assisting the larva in taking a firm hold, and in assuming an erect position. There is no trace of these setae in the full-grown larva, which strongly resembles those I have figured of the Bombyliids.

It is probable that this young Hirmoneura larva moves quite readily by the aid of these ventral appendages, and that it clings to the female Rhizotragus, and is carried into the ground by her when she enters the same to oviposit; and it is highly probable that the newly-hatched Bombyliid larva has similar organs that facilitate locomotion. I am inclined to believe that the hooked setae of Hirmoneura would rather impede than facilitate burrowing, and that they perform rather the same service as the tarsal ungues and anal spinneret of those Meloid triungulins which fasten to burrowing-bees in order to be carried where

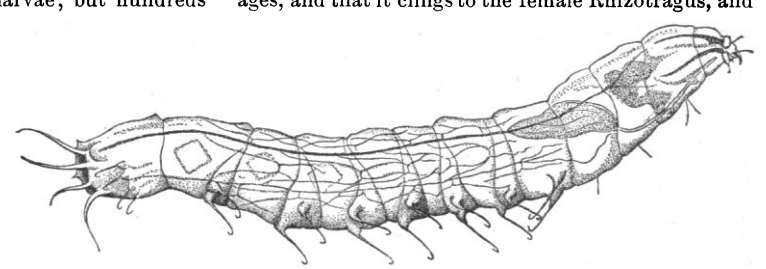


FIG. 2. — Newly-hatched larva, greatly enlarged. (After Handlirsch.)

[1] Die metamorphose und lebensweise von Hirmoneura obscura Meig., einem vertreter der dipterenfamilie Nemestrinidae. — (*Wien ent. zeit.*, 1882, 224–228; 1883, 11–15, tab. 1.) See also Dr. Fr. Brauer's Ergänzende bemerkungen, etc. — (*Ibid.*, 1883, 25, 26.)

they will find their food-supply, and opportunity to develop. In this view of the matter, the development of such non-homologous parts for analogous purposes is of great morphological interest. The analogy with the young Meloids will doubtless be found to go still farther, in that the young Bombyliid

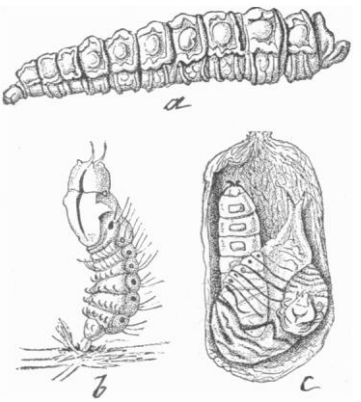


FIG. 3. — *a*, full-grown larva; *b*, pupa-shell; *c*, larva issuing from pupa of Rhizotragus. (After Handlirsch.)

will hibernate and otherwise live for a long time without food, waiting patiently for the hatching and growth of its intended victim, which growth may be very rapid among lamellicorns and pectinicorns, as I have shown in the case of Passalus cornutus (*5 Mo. ent. rep.*, 55), in which full larval development from the egg requires but six weeks. C. V. RILEY.

LETTERS TO THE EDITOR.

[*Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*]

The Lake-Superior rocks.

IN SCIENCE for Feb. 9, Mr. Selwyn refers to what he regards a 'mistake' of mine, in quoting him as believing that the trap and sandstone of Lake Superior are of the age of the Huronian. The statement was made on the authority of his report for 1877–78, p. 14 A., where, in his general classification, he has placed in the Huronian "the typical or original Huronian of Lake Superior, and the conformably — or unconformably, as the case may be — overlying upper copper-bearing rocks." I could not, of course, in 1881, state what Mr. Selwyn may believe in 1883, regarding the trap and sandstone of Lake Superior. A fair inspection of the Tenth annual report of the Minnesota survey, which he criticises, would have shown him that that opinion was quoted from him in 1877–78, since his report for that year is given as authority for the statement on the following page. Still, I am very glad to be re-enforced in the views which I have advocated in my reports since 1872, first promulgated by Messrs. Foster and Whitney, by the distinguished authority of the director of the Canadian survey. I concur with him in the sweeping affirmation, "that there is, at present, no evidence whatever of their holding any other place in the geological series" than that of the 'Potsdam and primordial Silurian;' and I would also add, that there is much incontestible evidence that they *can hold no other*.

In SCIENCE for March 9, Mr. Irving has misquoted and misrepresented my views in three respects: 1. That I have *strenuously refused* to believe in the unconformability of the sandstone and trap at Taylor's Falls in the St. Croix valley; 2. That, after my visit to the valley in 1881, I *confess to the unconformity;* and, 3. That I have *argued a difference of age* between the 'eastern sandstone' of the south shore of Lake Superior, and that of the St. Croix valley.

In respect to the first of these, it is only necessary to refer to the First report of the Minnesota survey (p. 69, 70), where the unconformity of the St. Croix sandstone on the trap and sandstones is made a strong point in the argument for separating the two under different names.

Secondly, I should hardly regard that a 'confession,' in 1881, which is the same that I advocated in 1872, and, in the interim, on all suitable occasions.

Thirdly, as to the difference of age between the sandstones of the St. Croix valley and those of the eastern southern shore of Lake Superior, probably Mr. Irving has misapprehended my argument in the Tenth report, Minnesota survey. Instead of ranking them of different age, I have grouped them as of the same age (p. 134), and call special attention to the fact, that the late investigations of Dr. Rominger, as well as the paleontological discriminations of Mr. Billings, go to show their identity. I have, however, a strong inclination to concur with Mr. Irving in the opinion that the 'Animikie group' of Thunder Bay is the equivalent of the original Huronian, and have already expressed reasons for such a supposition (Tenth report, p. 95). Some further examination in the northern part of Minnesota is still necessary to establish the parallelism. N. H. WINCHELL.

Minneapolis, Minn., April 2.

Venturesome spiders.

In the summer of 1882, while engaged for the U. S. coast and geodetic survey in the triangulation of New Hampshire, I witnessed an exhibition of tight-rope, or perhaps I ought to say slack-rope, performance, that somewhat surprised me at the time, and which may, perhaps, be of interest to your readers. It was upon the summit of one of our New-Hampshire hills, some 1,400 feet above sea-level, bearing the name of Blue Job. The air was clear, and the sky partially overcast with cumuli clouds, with a very light breeze from the east. After completing a series of measurements upon an angle, I stepped for a moment to the western side of my observatory (a small wooden structure, with shutters opening breast-high for observation); and, standing near the north-western corner of the building, I observed, starting out suddenly, and at almost the same instant, three spiders, each spinning out his single thread as he went, lying, back downwards, upon nothing but the air, and sailing off at an angle of, perhaps, 10° to 15° above the horizon, as if bound to some other sphere. The rate of motion was not more than a third or half metre per second; and as the air was very clear, and I soon had the advantage of a bright cloud for a background, I was able to watch the dark specks for a long distance. One of them made a partial failure, if his object was a long voyage, for he came to the ground within ten or fifteen metres; while the other two went on and up as far as the unaided eye could follow them, or perhaps I should say one of them did, for at last I was obliged to relinquish one, to be sure of holding the other in view. The distance to which the one was followed could not have been, I think, less than fifty metres.

The question arises, How did they do it? They went, it is true, in the direction of the wind, what there was of it; but this was so light that I judged at

the time there was not wind enough to do more than to swing the spider to the same angle from the vertical that he was then making above the horizon. It seemed the more surprising, as the spiders were large, and ought, by all the laws of gravity, to have fallen to the earth at once. And what was their objective point, aiming, as they did, for the clouds and stars? But I content myself with the statement of the facts, leaving to others the how, why, and whither.

E. T. QUIMBY.

Hanover, N.H.

Improvement of western pasture-land.

In his article in SCIENCE, p. 186, Professor Shaler's opening sentence, "that the greater part of the United States west of the meridian of Omaha is unfit for tillage," leaves a somewhat wrong impression. The greater part of Nebraska is west of that meridian; but nearly the whole state, as far as longitude 99°, produces crops of the cereal grains, grasses, corn, fruit, and roots, more surely, even, than the middle states. This area embraces 30,000 square miles. Large sections west of the 99th meridian produce almost equally well, as our statistics show. His suggestions, however, apply to the proper management of the grasses outside of this area, and are of very great importance.

A remarkable peculiarity of our Nebraska flora is its changing character. While not confined to the grasses, it is especially conspicuous among them. When I first crossed this county (Lancaster) in 1865, buffalo-grass (Buchloe dactyloides) covered much of the uplands. By 1871 nearly all of this species had disappeared; and its place was taken by blue-joints (Andropogon furcatus, etc.), interspersed with Boutelouas, Sorghum nutans, Sporobolus, etc. Again, in 1878, the blue-joints disappeared from entire townships, and the Boutelouas usurped their place. Similar phenomena were observed in almost every county in the state, and even in sections where settlements had not penetrated. During the last two years Sorghum nutans has been gaining in eastern Nebraska over all other species. On the whole, the species indigenous to moist regions have been gaining on the buffalo-grasses to such an extent that the latter have almost entirely disappeared east of the 100th meridian, and from large areas farther west. In extreme north-western Nebraska, on tributaries of the Niobrara, I have observed, since 1865, a remarkable exchange of buffalo-grass for Boutelouas and other grasses in different years. This tendency, therefore, is common, though not to the same extent, in the drier as well as the moister portions of the state. When old Fort Calhoun, above Omaha, was occupied by the military, twenty-five years ago, Kentucky blue-grass was brought in baled hay to that post from the south. It spontaneously took root, and spread in every direction, and now it can be found on prairies thirty miles away. Many of our farmers in eastern Nebraska are looking to that species now for a grass to give late fall and early spring pasturage.

Under favorable conditions, the wild native grasses produce a remarkable amount of hay. The blue-joints range in productiveness from one to three tons and more per acre. The latter large yield has been realized even at the 99th meridian on the wide Elkhorn-river bottoms. All the facts noted in the moist as well as dry sections of the state confirm Professor Shaler's theory; namely, that the natural conditions on the plains are most favorable to a changing grass vegetation, and that it is possible, through the agency of man, greatly to improve on the native species.

SAMUEL AUGHEY.

Apparent attractions and repulsions of small floating bodies.

As I thought it worth while, in the interests of clear teaching, to object (SCIENCE, i. p. 43) to certain things in Professor John Leconte's explanation of the 'Apparent attractions and repulsions of small floating bodies,'[1] it seems my duty, now that Professor Leconte has replied (SCIENCE, i. p. 249) to my criticism, to justify that criticism, or, failing in that, to acknowledge my error.

A statement in his explanation of the behavior of two moistened floating bodies, to which I particularly objected, was the following: "But when brought so near that their meniscuses join each other, the radius of curvature of the united, intervening, concave meniscus . . . is less than that of the exterior concave meniscuses, . . . and its superior tension acts upon both bodies toward a common centre of concavity."

The parts omitted from this sentence are merely references to a diagram. Professor Leconte now states that he should have said *superior force* instead of *superior tension*. I, however, objected to the statement on quite other grounds. After quoting it, I said, "We do not think physicists generally will admit that a liquid film tends *to draw a solid, to which it is attached, toward the centre of concavity of the film*. Indeed, if this were so, the tendency of a column of water raised between two floating bodies by surface-tension would be to lift those bodies. Similarly, a column of liquid sustained in a fine tube would tend to lift the tube."

I have quoted myself thus at length, — using italics, which I did not use before, — because Professor Leconte appears to understand me as denying that what he calls the 'capillary forces' — such, for instance, as the force exerted upon the enclosed air by the film of a soap-bubble — are directed toward the centre of concavity of the film. I spoke merely of the force exerted upon *the body to which the edge of the film is attached;* and the force exerted by the film upon such a body is certainly not directed toward the centre of concavity of the film. If we coil a rope round a cask, and set a man to pull at each end of the rope, the pressure on the cask will be everywhere directed toward the centre of curvature of the coil: but the pull on the men will not be toward the centre of curvature of the coil; it will be tangential to the coil. In the same way, the action of a meniscus upon the water beneath it, or the air above it, is directed toward the centre of concavity of the meniscus; but the action of the meniscus upon the body to which it is attached is tangential to the liquid surface, and perpendicular to the bounding edge of the meniscus.

Professor Leconte, however, has chosen to make the statement I have quoted above; and to my criticism thereon he replies, "Indeed, it is obvious that the elastic reaction of the common meniscus, formed when two such floating bodies are brought near to one another, *does not tend to lift them;* for the *vertical* component of the capillary forces, directed toward the centre of concavity, is exactly counterbalanced by the weight of the adhering liquid elevated between them, while the *horizontal* component is free to draw them together." He makes a similar statement concerning the action in a capillary tube.

It is, indeed, obvious, that the weight of the water must be sustained; but how and where is this weight applied to the floating bodies or to the tube? If it is applied by means of the surface-film, and at the line where the bounding edge of that film meets the floating bodies, or the wall of the tube, Professor Leconte's

[1] Amer. journ. sc., December, 1882.

final statement of the case of two floating bodies apparently comes to this: that the concave meniscus "acts upon both bodies toward a common centre of concavity," and also exerts upon these bodies a vertical downward force equal to the weight of the water sustained. If this is Professor Leconte's conception of the case, I do not feel to blame for not understanding him at first.

If, on the other hand, he supposes the weight of the water to be applied to the floating bodies, not by means of the surface-film, but in some other manner, it was, I submit, incumbent upon him to explain how and where he supposed it applied.

So much in explanation and support of my criticism of Professor Leconte's original statement. It is now, perhaps, worth while to examine a little further his final statement, as quoted above, beginning, "Indeed, it is obvious." Does not this statement, taken in connection with his first statement, also quoted above, lead directly to the conclusion that he supposes a column of water may be sustained between two bodies by capillary action without exerting any *resultant* downward force upon these bodies? — that, in short, the water is pulled *up* without any resultant tendency to pull the bodies *down*?

I have written thus at great length, and with perhaps unnecessary statement of elementary principles, because I intend this letter to be final upon my part.

Edwin H. Hall.

Harvard college, Cambridge, Mass.

THE INDIANA GEOLOGICAL REPORT.

Indiana: department of geology and natural history. Eleventh annual report (1881).. John Collett, state geologist. Indianapolis, *State*, 1882. 401 p., 55 pl. 8°.

This volume contains some interesting scientific and economic matter, partly original, but largely in the form of useful reprints of things not accessible to the people whose needs it is meant to serve.

There is, in the first place, the report of a well-made inquiry into the transverse strength and elasticity of building-stones, principally of the excellent oolite of the St. Louis division of the sub-carboniferous limestones. The point is well made, that the resistance of hammered blocks of stone to compressive strains is very much less than that of sawed masses, owing to the unseen disintegration of the mass produced by the blows of the hammer. There is also the noteworthy suggestion, that the modulus of resistance to compression may be approximately estimated by the 'ring' of the mass when struck.

There are several county reports which have no general value. They contain some venturous discussions of the extremely difficult problems connected with the work of the last glacial period in the Ohio valley. Glacial rivers, glacial lakes, ice-fronts, and all the other machinery of that time, are handled with charming ease and dexterity. We only hope the observers will work past this first transparent stage of the inquiry, and find how beyond imagination hard is this task of explaining the work of the ice-time, and how useless are such vague conjectures unfortified by the amplest delineation of facts.

In the report of Mr. Collett on Shelby county, we find the very interesting statement, that, in several wells sunk in one part of this county, heated waters have been struck within fifty feet of the surface. Nothing is given concerning the amount of flow of these waters or their chemical composition, nor are we told any thing concerning the goodness of the thermometers with which the observations were made, — all very important points. We only have the statement that the water was not potable, and that its temperature was as high as 86° F. As this district is below the level of the carboniferous series, it may not be reasonable to suppose that the temperature is due to the decomposition of iron pyrite, the only considerable known sources of that mineral available in this district being in the coal-measures. It is perhaps more probable that the temperature is due to downward penetration and return of water in a system of faults, which we must suppose to extend to a great depth, though they do not manifest themselves on the surface. If the waters are highly sulphurous, the origin of the heat in the decomposition of pyrite is the most probable; if they are not sulphurous, their source must be sought in faults. The question merits a careful study.

Two hundred pages of the text, and thirty-two of the plates, are reprints of James Hall's Waldron fossils, with some emendations, including four new plates.

Dr. Charles A. White gives a series of plates and descriptions of fossils from the collection of Mr. J. W. Van Cleve. Hall's monograph is well known to but few. It was originally published in the twenty-eighth report of that mysterious body corporate, the regents of the university of New York. This is the first publication of it that could have been of any use to Indianian students.

The species described by Dr. White are chiefly corals, and are not regarded by the author as new species. This part of the work is essentially of local interest. All the species have been better set forth before, but never in a form so accessible for the dweller in the rural parts of Indiana.

Although there is not much that is original in this book, it very likely has a higher measure of utility for the people who pay for it than many a survey report that has better served the purposes of pure science. The old

day when the advance of American geology seemed to depend on state surveys is passing, and will soon pass away. They did good skirmish-work, and deserve to be remembered for many gifts to science; but the problems in scientific geology are now too large to be solved within the limits of a state. Scarce a state in this country has a question that can be properly considered from work done within its limits alone. In the future the state surveys can find their best place, not in efforts to develop general scientific problems, but rather in economic questions, which can always be localized, and in the work of bringing to the notice of the people whom they serve such matters of pure science as may naturally concern them. Other forms of research would better be left to the general government surveys, or to the studies of independent geologists.

It is now pretty well ascertained that our states are unwilling to support permanent scientific establishments on such a scale as will enable them to do good scientific work, but they will pay some one or two men to keep a sharp lookout for any utilities that may be discovered. Fortunately nature so mingles the 'utile' and the 'dulce,' that some good to science will come out of this care for profit, which is to be in the future the task of the state surveyor.

M. HERMITE'S LECTURES.

Cours de M. Hermite, professé pendant le 2e semestre 1881-82. Redigé par M. ANOYER, *élève de l'École normale supérieure. Second tirage revu par* M. HERMITE (*Librarie scientifique*). Paris, *A. Hermann*, 1883.

THIS work of M. Hermite fills, in great part, a decided gap in mathematical literature, and affords a means to American mathematical students, at least, of overcoming a difficulty that of late has become rather serious. With the exception of those who have had the opportunity of listening to the lectures of Hermite or Weierstrass on the theory of functions of a complex variable, all students interested in that subject must have experienced a great deal of difficulty in reading the more modern memoirs which deal with it. Some such book as Durége's, or Neumann's, on Riemann's theory, is very much wanted on what may, with propriety, be called the Weierstrass-Hermite theory of functions. The necessity for such a treatise is steadily increasing, as any one will readily see by looking over the last few volumes of *Crelle-Borchardt*, the *Mathematische annalen*, the *Annali di matematica*, or the two numbers which have already appeared of *Mittag-Leffler's acta mathematica*. The present work by M. Hermite does not profess to be such a treatise. In fact, it is not a treatise at all, but, as its title implies, simply the course of lectures given at the Sorbonne by M. Hermite, and treating of quite an extended list of subjects. The principal topics discussed are the quadrature and rectification of curves, the determination of the areas and volumes of curved surface, the general theory of functions of a complex variable, and the application of this theory to the study of the Eulerian integrals and the elliptic functions.

The first five chapters are devoted to geometry, and contain applications which are chosen with a view to what is contained in the succeeding chapters. Since, for the rectification of conics and the quadrature of plane cubics, it is necessary to consider integrals of the form $\int f(xy)\,dx$, where $f(xy)$ is a rational function of x and y, and y is the square root of a quartic function of x, the author takes up this general integral, and gives Legendre's reduction to the normal forms of the elliptic integrals, and also some of Tchebychef's results concerning the cases where the elliptic integrals are reducible to algebraico-logarithmic functions.

The next three chapters are taken up with an exposition of the more elementary properties of functions of a complex variable, the author giving an account of Darboux's investigations relatively to the integral $\int_a^b \mathrm{F}(x) f(x)\,dx$, where $\mathrm{F}(x)$ is, between the limits, always positive, $f(x)$ is a continuous function of the form $\phi(x) + i\psi(x)$, and where a and b are real. Another method, due to Weierstrass, for integrals of this nature, is also indicated.

In the next four chapters the immediate consequences of Cauchy's theorem are developed, and an account given of Weierstrass's and Mittag-Leffler's investigations in the theory of uniform functions, including their decomposition of a holomorphic function into prime factors, and their general expression for a uniform function with an infinite number of poles, or of essential singular points, the last being due almost solely to Mittag-Leffler.

The next three chapters deal with the Eulerian integrals, and include Prym's expression for $\Gamma(x)$, and Weierstrass's expression for $\frac{1}{\Gamma(x)}$, and a demonstration by M. Hermite of Laplace's formula for the approximate calculation of $\Gamma(x)$, where x is a very large integer.

The next two chapters refer to functions which are discontinuous along a line, — Appell's and Tannery's series, and Poincarré's example of a function having an *espace lacunaire*. As preliminary to Cauchy's theorem concerning the number of roots of a polynomial contained in the interior of a contour, the expression is given by a line-integral of roots of an equation contained within a given contour. Then follows Cauchy's theorem, the establishment of Lagrange's series, Eisenstein's theorem upon series whose co-efficients are commensurable, and which satisfy an algebraical equation, and the enunciation of Tchebychef's theorem upon series with rational co-efficients, which may represent functions composed of algebraic, logarithmic, and exponential functions.

The next chapter treats of multiform functions arising from the integration of uniform and of multiform functions, and of the means of reducing them to uniform functions by systems of cuts (*coupures*).

The remaining five chapters treat entirely of the doubly-periodic functions. After first showing the multiple values of the elliptic integrals of the first kind which correspond to the different paths traced out by the variable, and establishing the double periodicity of the inverse functions to this integral, he defines a function, $\Phi(x)$, which conducts to the analytical expressions for the doubly-periodic functions. The function $\Phi(x)$ is defined by the equations, —

$$\Phi(x + a) = \Phi(x)$$

$$\Phi(x + b) = \Phi(x) \exp.\left[-\frac{ki\pi b}{a}(2x + b)\right],$$

where k is an integer. Then follows the investigation of the elliptic functions, including, of course, Jacobi's Θ, H, and Z functions, the definition of Weierstrass's functions, Appell's expression for doubly-periodic uniform functions in the case where they possess essential singular points, and, finally, a demonstration by M. Goursat of Fuch's theorem concerning the definite integrals K and K', considered as functions of the modulus.

It is perhaps to be somewhat regretted that the book is lithographed instead of printed in the usual manner; but this is of comparatively little consequence, as the writing is very clear and legible. Thanks are certainly due to M. Andoyer, the editor, for the trouble which he must have taken in elaborating what would seem to have been merely a set of notes on M. Hermite's lectures. The whole matter has been revised by M. Hermite, and the aggregate result of his and M. Andoyer's labors is a book which is a decided acquisition to mathematical literature. It is to be hoped that M. Hermite will see fit to go more fully into the subject of the functions of a complex variable, and that of elliptic functions, at a future time, and give to the world a treatise which will be more satisfactory than even the present very valuable work. T. CRAIG.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

ASTRONOMY.

New measures of Saturn's rings. — O. Struve gives the results of a series of measurements of the rings of Saturn at Pulkowa during August and September, 1882, compared with a similar series, also taken by himself, with the same instrument, and at the same time of the year in 1851. In a memoir on the subject in 1851, he seeks to prove, that, while the outer diameter of the rings remains constant, the inner is continually shortening, basing his conclusions on the observations and drawings from Huygens's time. If the conclusion were correct, and the contraction constant, the measures of 1882 should have given a perceptibly shorter inner diameter than those of 1851. The inner diameter of the dark ring seems to be slightly shorter than in 1851, but the difference is not nearly so large as the theory calls for. The dark ring seems, however, to have changed since 1851. Then it seemed divided by a dark streak, the inner part being entirely separate from the bright ring. In 1882, all trace of this division had disappeared, and the dark ring seemed to be merely a faint continuation of the bright ring. — (*Astr. nachr.*, No. 2498.) M. MCN. [688

Formation of the tails of comets. — Mr. Rumford suggests that the repulsive force which is unmistakably manifested in the formation of comets' tails may be due, not to any electric action, or any imagined impulse of solar radiations, but merely to evaporation. A small particle from which evaporation is taking place on the side next the sun will be driven backward with a velocity continually accelerated; and, when more than half of the mass of the particle has been evaporated, the velocity of the residue may be much greater than the average velocity with which the gaseous molecules are driven off from the heated body. In the case of hydrogen at a temperature of 70° or 80° F., the velocity thus acquired might be greater than a hundred thousand miles a day. If we suppose the evaporating material to be gases which have been liquefied by the cold of space (carbon dioxide and volatile hydrocarbons), it becomes easy to account for a powerful repulsive action at distances from the sun even much greater than that of the earth. The writer suggests that the comet's light may be in part due to the 'bombardment' of precipitated particles by the evaporated molecules in the condition called by Crookes 'the fourth state of matter'; so that, "without electrical discharges,

the whole phenomena of the continuous and bright line spectrum in the neighborhood of the nucleus may be accounted for." He also discusses briefly some of the polarization phenomena of comets, and the envelopes which appear near the nucleus. The article is a very interesting and suggestive one; but in view of the fact that comets' tails sometimes grow, not a hundred thousand, but more than a million miles a day, it is doubtful whether the proposed hypothesis can be regarded as sufficient. — (*Astr. reg.*, March.) C. A. Y. [689

GEODESY.

Altitude of Lake Constance. — Part of the work laid out by the European geodetic commission consists in carrying an accurate series of levels across the country, and a share of this has recently been completed by the royal Prussian geodetic institute. It is published as the *Gradmessungs-nivellement zwischen Swinemünde und Konstanz*, by W. Seibt (Berlin, 1882), and records the altitudes of a large number of points from the Baltic, where the datum plane is the mean water-level from fifty-four years' observations, to Lake Constance, where connection is made with the Swiss triangulation. The railway station in Constance is 399.990 met. above the Baltic. — (*Verh. ges. f. erdk.*, Berlin, 1882, 514, 538.) W. M. D. [690

MATHEMATICS.

Symmetric functions. — Previous mention has been made of Mr. Durfee's tables for the twelfthic. By a curious coincidence, M. Rehorovsky of Prague has, almost simultaneously with Mr. Durfee, computed the same tables. M. Rehorovsky's tables differ from those of Mr. Durfee only in arrangement. The tables as arranged by the former are identical in form with those given by Prof. Cayley for the first ten orders in the *Phil. trans.*, vol. 147; while those of Mr. Durfee are arranged symmetrically, and cannot be included in a half-square, as M. Rehorovsky's are. — (*Sitzungsb. akad. wissensch. Wien*, 1882.) T. C. [691

Maximum value of a determinant. — The elements of a determinant being restricted to lie between $(-a)$ and $(+a)$, Mr. Davis finds, that, for all determinants whose order is greater than 2, a numerical maximum is found by making all the elements of the principal diagonal $= -a$, and all the remaining elements of the determinant $= +a$. In the maximum cubic determinant $D_n^{(3)}\, a^n$, all of the strata are made identical, and equal to $D_n^{(2)}$. The value of this determinant is $\pm\, n!\ D_n^{(2)}\, a^n$. Formulae are also given for hyperspace determinants. — (*Johns Hopk. univ. circ.*, No. 20.) T. C. [692

Functions of several variables. — M. Combescure seeks to develop completely the immediate conditions to be satisfied by an analytic function of several imaginary variables. Assuming $z_1, z_2 \ldots z_n$ as the variables, these are defined by the equations $z_j = x_j + iy_j$, where $j = 1, 2 \ldots n$. Then the function to be considered is $F(z_1, z_2 \ldots z_n) = \phi + i\psi$. The differential co-efficients of ϕ and ψ of the first order are connected by relations precisely similar to those connecting these quantities when there is only one variable, z: so, when one of the functions ϕ or ψ is given, the other may be found by simple quadratures. It is shown that the group of conditions for the determination of ϕ reduces itself to the $\frac{n(n+1)}{2}$ partial differential equations of the second order, $\Delta_{h,k}\,\phi = 0$, where

$$\Delta_{h,k} = \frac{d^2}{dx_h\, dx_k} + \frac{d^2}{dy_h\, dy_k},$$

for $h, k = 1, 2 \ldots n$, and, of course, including the cases where $h = k$. These are the necessary and sufficient conditions to be satisfied by ϕ. A means is given of representing ϕ analytically by an exponential series, the co-efficients of which depend upon the sines and cosines of $(a_1 x_1 + \ldots + a_n x_n)$ and $(\beta_1 y_1 + \ldots + \beta_n y_n)$; $a\ \beta$, as well as the constant co-efficients of these sines and cosines, being indeterminate real quantities, to which we can give any values we please. — (*Comptes rendus*, Jan. 22.) T. C. [693

Homologies and conics. — If L and M are two fixed points on a conic, K, and P a variable point, then P H, perpendicular to L M, cuts again the circle L M P in a point, H, which describes a conic, K′. If the circle on L M as diameter cuts K again in E F, then L M and E F are the axes, and the point at infinity in the direction P H is the common centre of two of the twelve homologies which two conics in general determine. The ratio of corresponding areas of K and K′ is constant, — a function of the eccentricity of K and of the inclination of L M to the focal axis of K. Given, on the other hand, the centre and axes of the homology, two triply infinite systems of conics, K and K′, can be determined; the conics of each system being similar and similarly placed, and the common points at infinity of one system being orthogonal to those of the other. All the conics of the plane are thus distributed into a doubly infinite number of triply infinite systems. The net of conics determined by three arbitrary points in a plane will give a doubly infinite number of conics, one out of each system, and hence will produce all the homologies of the plane, and each once only. There is therefore a (2,1) correspondence between the doubly pointed plane and the plane of the homologies. The discussion of these points by Luigi Certo is followed by an investigation of the variation of the ratio of corresponding areas, first, with the variation of the eccentricity, and, second, with the variation of the direction of the line L M. He also considers the distribution in the plane of the pairs of similar conics of which the system of conics through four points on a circle is composed. — (*Giorn. mat.*, XX.) C. L. F. [694

PHYSICS.

Optics.

Color of water. — W. Spring reviews the several explanations suggested to account for blue and greenish colors of water in lakes and seas, — Bunsen's idea of inherent color, Tyndall's theory of reflection, and others, — and concludes that some further study of the question is needed. Blue from reflection would imply red by transmission, but this is not observed from diving-bells. The author concludes provisionally that the color depends on the presence of certain salts, especially calcic carbonate in solution. The more complete the solution, the bluer the water. — (*Rev. scient.*, 1883, 161.) W. M. D. [695

(*Photometry.*)

Spectrum photometry. — MM. J. M. de Lépinay and W. Nicati have recently completed an investigation of the relative brilliancy of white surfaces when illuminated by different colored lights and by different portions of the same spectrum. In the preliminary experiments, two lights were employed, — a yellow and a blue one, — the blue light being the fainter. Their intensity was compared by means of a Rumford photometer, casting very small shadows.

Two experiments were tried. In the first, the yellow light remained stationary, and the blue one was moved towards the screen till equality of the shadows was obtained. In the second experiment, the blue light was left in its first position, and the yellow one moved away from the screen till the shadows were equal. On comparing the results obtained, it was found that they differed materially from one another. In another experiment the two shadows were cast so that when the eye was in a certain position they appeared of equal brilliancy. On approaching the screen, the blue shadow was found to appear more brightly lighted than the other; and, on going away from the screen, the reverse effect was observed. To further investigate these results, two methods of measurement were employed: 1. The intensity of the light corresponding to the different wave-lengths of the spectrum was determined by means of a Rumford photometer, as above described; 2. A small figure consisting of three short, broad, black lines, drawn on a white surface, was placed in different portions of the spectrum, and the intensity of the light increased or diminished until its outlines were just distinguishable.

It was found that the results obtained by the two methods agreed almost exactly for the less refrangible portion of the spectrum, as far as wave-length 517; but beyond that point the differences suddenly became very marked; and it was shown that a blue light had to be many times brighter than a yellow one in order to distinguish the same details by its aid; also, that the brighter the lights were, the more marked did this difference become.

Now, for purposes of artificial lighting, whether public or private, the end desired is less to produce a luminous sensation upon the eyes than to enable us to distinguish the objects around us. It is therefore concluded, that, for lights of equal brilliancy, the superiority of yellow sources (such as gas-flames and incandescent electric lamps) to sources richer in the blue rays, as the arc light, is beyond question. — (*Journ. phys.*, Feb.) W. H. P. [696

Electricity.

Transmission of power. — Experiments relating to the electrical transmission of power were made on the 4th of March last, in Paris, at the *Chemin de fer du Nord*, before a commission of the French institute, composed of MM. Bertrand, Cornu, Tresca, de Lesseps, and de Freycinet. The resistance of the line was 160 ohms, — a resistance equivalent to that offered by a copper wire 106 kilometres in length, and 4 mm. in cross-section. The power applied to the generating-machine was equivalent to 4.4 horse-power; and the rotation of the generating armature was varied from 380 to 1,024 revolutions per minute in order to ascertain the effect of speed of rotation upon the mechanical return at the other end of the line. As the general result of the experiments, '*La Lumière électrique*' announces that the available power transmitted was 47.5% of that which actuated the generating-machine. — (*La Lum. électr.*, March 17.) A. G. B. [697

ENGINEERING.

Steel for structures. — Mr. Ewing Matheson discusses at considerable length the important question of the modern use of steel for engineering-works. The author commences by stating the following propositions: 1. Rolled plates and bars of the various forms required for structures are now made of steel with as much certainty, in regard to quality, as iron of the first class; 2. Advantages in regard to size and weight of pieces can be obtained in steel, which in iron are either impossible, or can only be had at very great expense; 3. Steel has a superiority in strength, ranging from once and a half to twice that of iron, and at the same time a more than proportionate superiority in ductility and elasticity; 4. Steel can be bent, straightened, cut, punched, planed, and drilled with the same tools and processes that are used for iron, and, for the most part, without extra force; 5. Protection against rust is of more importance for steel than for iron, but, if treated in the same way as is usual with iron, steel is less liable to waste by rust; 6. Owing to the above advantages, structures of steel are superior to those of iron, but economically it is only in some cases in regard to ships, and in still fewer cases in regard to bridges, that there is at present any pecuniary advantage in using steel; 7. This limit to the application of steel is due partly to official rules, which restrict the working-strains on steel, and partly to exigencies of design, which hinder the reduction in size and weight of members to the extent which its superior strength might otherwise allow; 8. Although, for the above reasons, steel structures may cost more than iron without any immediate compensation, yet, if measured by actual units of strength and durability, steel is cheaper as well as better for all but very small structures; 9. The employment of steel may be encouraged and extended by a fuller knowledge, among those who use it, of its qualities, by facilities for verifying these qualities by exercising a wider choice of the kind of steel suited to the purpose in view, and by such a liberal alteration of the present official rules as will allow fuller advantage to be taken of steel than is usual or permitted at present. The simplicity of manufacture, as compared with that of rolled iron, renders almost certain a nearer approximation in cost, if, by a wider permission, the demand for steel should increase. Each of the above points is taken up in detail and carefully considered, the admiralty specifications for steel plates for ships are given, the question of steel riveting is examined, the important matter of rust is discussed, and an extended comparison is made between the weight and cost of iron and steel for bridges. The whole paper is of great value, and well worth careful study. — (*Proc. inst. civ. eng.*) G. L. V. [698

Recent hydraulic experiments. — At a meeting of the Institution of civil engineers held in London Nov. 14, 1882, Major Allan Cunningham gave an account of an extensive course of experiments on the flow of water in the Ganges canal, extending over four years (1874–1879), the principal object being to find a good mode of discharge measurement for large canals, and to test existing formulae. Not less than fifty thousand measurements for velocity were made, and six hundred for surface slope, while five hundred and eighty-one cubic discharges were measured under very varied conditions. Forty measurements of evaporation from the canal surface were made in a floating pan, during twenty-five months. The results showed the movement of water in such a canal to be in many respects quite different from those before reported. — (*Engineering*, Nov. 17, 1882.) G. L. V. [699

Railroad accidents, and the earth's rotation. — R. Randolph shows that the deflective force arising from the earth's rotation is entirely too small to determine derailments, and also, that, as an excess of right-handed derailments has been credited solely to north and south tracks, this proves it to be wholly imaginary; for the deflective force at any latitude is the same for all directions (*Van Nostrand's engin. mag.*, 1883, 117). The numerical results given are but half

their true value, as two elements of the deflective force are omitted (SCIENCE, p. 98); but this does not affect the author's conclusions, as the deflective force is still insignificant, and, for a fast train in this latitude, amounts to but about $\frac{1}{5000}$ of the weight. — W. M. D. [700

The type of modern marine engines. — Constructing-engineer Albrecht, of the Austrian navy, discusses the various forms of engines and boilers which have been proposed or used, gives data and indicator-diagrams for various ships, shows that the compound engine effects a saving of fifty-seven per cent over the simple, and pronounces the three-cylinder compound engine the most economical and best. — (*Mitth. gebiete seew.*, x. 9.) C. E. M. [701

Torpedo-nets. — Lieut. Sleeman, R.N., proposes to render torpedo-nettings useless as a protection for ships by sending one Lay torpedo after another, in the same path, at short intervals. The first breaches the net; the second passes the breach, and explodes against the ship. — (*Journ. de la flotte*, Feb. 18.) C. E. M. [702

Pendulum-chronograph. — Capt. Caspersen, of the Danish army, has devised a chronograph for ballistic purposes, which consists of a pendulum prolonged above its point of suspension so that it can be arrested at its extremities at will by levers connected with electro-magnets. A horizontal wire is fastened at the point of suspension, with its ends bent so as to dip in cups of mercury; and thus, when the pendulum is oscillating, the contact is made alternately on the two sides, and registered automatically on a dial. The instrument measures with precision the hundredth of a second. — (*Mitth. gebiete seew.*, x. 9.) C. E. M. [703

CHEMISTRY.

(General, physical, and inorganic.)

Conduct of moist phosphorus and air towards carbonic oxide. — In repeating the experiments of Leeds and of Baumann, Prof. Ira Remsen and E. H. Kaiser observed a copious precipitate on passing the mixed gases through barium hydrate. When, however, all contact of the gases with corks and connectors was prevented, there was no formation of barium carbonate. — (*Amer. chem. journ.*, iv. 454.) C. F. M. [704

White phosphorus. — A modification of phosphorus, quite different in its properties from the variety hitherto known as white phosphorus, was obtained by Remsen and Kaiser in the distillation of ordinary stick phosphorus. The distillation was conducted in an atmosphere of hydrogen, and the distillate collected in a receiver partly filled with water and ice. At the end of the distillation a thin white cake was found floating on the surface of the water. It dissolved readily in carbonic disulphide, melted at the same temperature as the common form, and, on melting, was transformed into the latter. It withstood the action of sunlight longer than ordinary phosphorus. — (*Amer. chem. journ.*, iv. 459.) C. F. M. [705

Specific heat and valence of thorium. — On further study of the metal thorium, L. F. Nillson finds that it is tetratomic, and that its atomic heat calculated from the mean of several determinations of the specific heat 0.02787 is 6.4. Analogous to silicon, it forms a fusible alloy with platinum ; and the composition of its chlorplatinate corresponds to those of tin and zirconium. — (*Berichte deutsch. chem. gesellsch.*, xvi. 153.) C. F. M. [706

Formation of arsenides by pressure. — When a mixture of zinc filings and arsenic in powder was subjected to a pressure of 6,500 atmospheres, W. Spring observed the formation of an arsenide (Zn_3As_2). Corresponding arsenides of lead (Pb_3As_2), cadmium (Cd_3As_2), and of copper (Cu_3As_2), were also prepared. Varying the proportions of copper, Cu_6As_2 and $Cu_{12}As_2$ were formed. Tin gave Sn_3As_4, and silver Ag_3As and Ag_6As, the latter a brittle mass of metallic lustre and gray color. — (*Berichte deutsch. chem. gesellsch.*, xvi. 324.) C. F. M. [707

Production of apatites and wagnerites containing calcium bromide. — When sodium bromide is heated to a temperature just above fusion, and calcium phosphate is added to it, A. Ditte states that well-developed hexagonal pyramids separate on cooling, which have the composition $CaBr_2 . 3(Ca_3(PO_4)_2)$. On heating calcium bromide and calcium phosphate together, a compound ($CaBr_2 . Ca_3(PO_4)_2$) corresponding to wagnerite crystallizes in long needles. If calcium arseniate is used, instead of the phosphate, in the preceding experiments, in the first case the compound $CaBr_2 . 3(Ca_3(AsO_4)_2)$ crystallizes in hexagonal pyramids, and, in the second case, $CaBr_2 . Ca_3(AsO_4)_2$ is formed. When vanadic acid is fused with sodium bromide and calcium bromide, the chief product is a bromo-vanadate, $CaBr_2 . 3(Ca_3(VO_4)_2)$. The corresponding wagnerite ($CaBr_2 . Ca(VO_4)_2$) results when the acid is fused with pure calcium bromide. Analogous compounds may be formed in which calcium is replaced by other metallic elements. — (*Comptes rendus*, xcvi. 575.) C. F. M. [708

The atomic weight of lanthanum. — Since the atomic weight of lanthanum was reduced by the results of Brauner to 138.28 from 139.15, the value formerly obtained by Cleve, the latter sought to verify or disprove Brauner's result by a more careful preparation of the material from which the atomic weight was determined. From 1.5 kilos. of the mixed oxides of cerium, thorium, lanthanum, and didymium, the first two elements were removed by treating the partially decomposed nitrates with water, and didymium by fractional precipitation with ammonium hydrate. The seventh fraction was converted into the sulphate, and submitted to fractional crystallization. The last mother-liquor contained 10 grms. of the sulphate, which, on analysis, gave 138.69 as the atomic weight. Since a trace of didymium could still be detected by the spectroscope, the fractional crystallization was continued until analysis showed a constant percentage of lanthanum. The mean of several determinations gave 138.22 as the atomic weight. Cleve seeks to explain the difference between his results and those of Brauner by the different methods employed to obtain pure material. He thinks, that, since Brauner depended upon a fractional crystallization of the oxalates, his product may have contained a trace of yttrium. — (*Bull. soc. chim.*, xxxix. 151.) C. F. M. [709

METALLURGY.

Silver-milling at Charleston, Arizona. — According to Mr. W. Lawrence Austin, the ore, as the mine was developed, gradually changed, and was found to carry wulfenite (molybdate of lead). The bullion resulting from milling this changed ore ran down to from 200 to 300 fine. The fineness was again restored to 970 by stamping much finer, and giving up altogether the grinding in the pans; departing from the usual custom of stamping, 35 mesh to the inch, and grinding, and also by the use of lime in cleaning the amalgam. Cerussite and galenite did not cause the same trouble as wulfenite. — (*Eng. min. journ.*, Jan. 27.) R. H. R. [710

Refractory bricks. — The waste liquors from manufacturing potash salts at Stassfurt and Leopoldshall, containing 27 to 30% of chloride of magnesium, are now saved. The evaporated salt is treated, at an elevated temperature, with highly superheated steam in an oxidizing flame; and nearly chemically pure magnesia and hydrochloric acid of 21° Baumè, are obtained. This magnesia is well adapted, not only for making the cement of oxychloride of magnesia, but also for making magnesia firebricks, now so much used. — (*Eng. min. journ.*, Feb. 24.) R. H. R. [711

Proposed modification in copper-smelting. — Paul Johnsson proposes to heat the 35 to 40% copper matte, derived from cupola or other furnace smelting, in a Siemens furnace, and to direct a blast of air upon the surface of the molten metal, in order to oxidize the impurities, and to bring the matte forward to blister copper in one operation of 12 hours. He estimates that 20 tons of matte could be treated in one furnace, with the labor of 10 men, in 24 hours; while, by the old method, 8 calciners, 4 reverberatory furnaces, and 40 men, would be required to do the same work. — (*Eng. min. journ.*, March 3.) R. H. R. [712

Bessemerizing matte in a reverberatory furnace. — H. M. Howe refers to the article of Paul Johnsson (*Eng. min journ.*, March 3), and claims that the credit of the process belongs to the Orford nickel and copper company, and not to Paul Johnsson. —(*Eng. min. journ.*, March 17.) R. H. R. [713

GEOLOGY.

Lithology.

Lithology of the Eisengebirge. — The rocks of the Eisengebirge of Bohemia are divided by Helmhacker into three groups, — crystalline schistose rocks, crystalline massive rocks, and clastic (fragmental) rocks. Under the first are described rocks classed as amphibole gneiss, gneissoid granulite, porphyroid, mica schist, and phyllite; under the second group are placed red granite, gray granite, gneissoid granite, syenite, granite porphyry, quartz porphyry, felsite porphyry, diorite, diorite aphanite, diabase, gabbro, uratite diorite, corsite, and troktolite; and of the last, a diorite-tuff-conglomerate only is described.

Under the name 'porphyroid,' a term well known in the early part of this century and previously, Helmhacker places rocks which resemble quartz and felsite porphyry, but have a schistose structure. They possess a felsitic groundmass and crystals arranged in more or less parallel layers. Phyllite is divided into staurolite, andalusite, and ottrelite phyllite, and fruchtschiefer and lydite. In the thin section, the first is seen to possess a groundmass composed of sericite plates, between which biotite scales and magnetite grains were lying. The staurolite lies porphyretically enclosed in this groundmass, and shows aggregate polarization. In the second, the groundmass is principally composed of biotite scales and magnetite or anthracite grains. The andalusite in the thicker sections is of a pale rose tint; in the thinner, colorless. The ottrelite schist or phyllite was formed by the contact metamorphosis of black argillite with granite. This formation of ottrelite schist, by the action of intrusive rocks, agrees with the present writer's observations on Lake Superior (*Bull. mus. comp. zoöl.*, vii. 45). The ottrelite or chlorotoid plates are surrounded by a very fine, granular, scaly groundmass, formed principally of a muscovite-like mineral, which polarizes brilliantly. The irregular polygonal ottrelite plates have a pale grayish-green color, and are plainly dichroic. They are homogeneous, and, excepting some dust-like grains of magnetite, are free from inclusions.

The term 'troktolite' is the equivalent of the more common one 'forellenstein'; and the diabase-tuff-conglomerate belongs to that class of rocks which the present writer named in a briefer way, in 1879, porodite (*l. c.*, v. 280). Our space forbids an adequate idea of an extended paper filled with details. — (*Arch. natur. landesdurchf. Böhmen*, 1882, v. 87.) M. E. W. [714

METEOROLOGY.

Winds on sea and on land. — Mr. Alexander Buchan has recently discussed the observations of the wind made by the Challenger during its cruise of three years and a half, ending with May, 1876. Observations of the force and direction of the wind were made on 1,202 days, at least 12 times each day. Of these, 650 were on the open sea, and 552 near land. The seas were the North and South Atlantic, North and South Pacific, and the Southern Ocean.

Mr. Buchan finds the diurnal range of the wind-velocity on the open sea very small, not varying more than 1 mile, on either side of 17.5 miles per hour, during the 24; while near land the range was very marked, being nearly 15 miles per hour at 2 P.M., and only a little over 11 from 9 P.M. to 8 A.M. This he explains from the fact that the daily range of surface-temperature, for example, on the North Atlantic, is only .7°; and hence over the ocean the atmosphere rests on a floor the temperature of which is all but constant day and night. On approaching the land, however, the daily range of the temperature of the air over the sea becomes materially augmented, and amounts to 4.3°; and we know, from all observations, that on the land the range is still greater. This shows that the phenomena of the daily range of wind-velocity is intimately associated with that of the surface-temperature. Mr. Buchan writes, "So far as concerns any direct influence on the air itself, considered apart from the floor or surface on which it rests, solar and terrestrial radiation do not exercise any influence in causing the diurnal increase of the wind-velocity with the increase of temperature." On nearing land, the wind is everywhere greatly reduced in force, the retardation being due chiefly to friction. The winds were found lightest over the North Pacific (14.5 miles per hour), and strongest over the Southern Ocean (23.5 miles per hour). — (*Nature*, March 1.) H. A. H. [715

Rainfall of New South Wales. — A valuable map by H. C. Russell, for 1881, shows a fall of forty to sixty inches at several points along the coast north and south of Sydney, and diminishing to twenty or even ten inches on the plains of the Darling River, some five hundred miles inland. — (*Journ. roy. soc. N. S. Wales*, xv.) W. M. D. [716

Weather-predictions in Australia. — All the Australian colonies being now connected by telegraph, it is proposed to issue daily, at Melbourne, a weather-chart, showing atmospheric conditions at nine A.M., and attempting predictions for the following day, especially when cyclone disturbances show themselves within the vicinity of the coast. Most of these storms come from the southern Indian Ocean, and move east or north-east, sometimes running ashore, sometimes passing south of Tasmania. As the barometer falls on their approach, warm north winds come down with increasing strength from the heated interior country. Rain is generally heaviest with these winds, but sometimes falls to a considerable amount after the storm-centre has passed, the wind veering through the north-west, as a rule, but some-

times backing through the east when the centre passes inland. Australia sends storm-warnings by cable to New Zealand. Nearly every barometric depression observed in the former region reaches the latter, requiring two or three days for the intermediate ocean-passage. — (*Trans. roy. soc. Victoria*, xviii.) W. M. D. [717

PHYSICAL GEOGRAPHY.

Hawaiian Islands. — Preparatory to his studies of the Cascade range, Capt. Dutton, of the U. S. geological survey, visited the Hawaiian Islands last year. He regards Kilauea formed independently of Mauna Loa, and describes its lava-lake. The colossal eruptions of Mauna Loa were especially remarkable: that of 1855 would have built Vesuvius. The mountain has no cinder-cones; and when in eruption there is no roar of vapors or cloud of steam, but a huge river of fiery lava wells forth like water from a radial fissure on the mountain flank, sometimes beginning as a great fountain several hundred feet high, then swiftly flowing down toward the sea. The lava being very liquid, the volcano is abnormally flat, and, as yet, it has no streams or ravines upon it; but there are many long tunnels in the lava, which lead the drainage underground. Mauna Kea has numerous cinder-cones, which form striking features on its slopes. The difference between the erosion on its windward and leeward sides is very marked. The other islands were also examined. Haleakala, on Maui, presents grand scenery in its deep valleys; Oahu and Kaui are also deeply eroded, implying a cessation of their activity earlier than that of Hawaii, but not necessarily an earlier beginning. — (*Amer. journ. sc.* 1883, 219.) W. M. D. [718

GEOGRAPHY.

(*Arctic.*)

Norwegian arctic fishery in 1882. — The fisheries from Tromsö and Hammerfest employed 575 persons, in 67 vessels of 2,654 tons total burden, and produced, in 1882, 148 walrus, 5,839 seal of all species, 117 beluga, 49 polar-bears, 211 reindeer, 332 kilos eider-down, 65 hectolitres whale-blubber, 261,400 haddock, 369 hectolitres of haddock-livers, and 2,430 of other fish-livers, — having a total value of some 210-,000 kronor, or about $60,000. — (*Deutsch. geogr. bl.*, vi. i. 1883.) W. H. D. [719

Commerce of the White Sea. — In curious contrast with prevalent notions about the arctic regions, are the statistics of trade between the four ports of Norwegian Finmark and the Russian ports of the White Sea, especially Archangel. In 1881 four hundred and seventy vessels, employing over two thousand men, visited the Finmark ports; and in 1882 a still larger number, bringing goods, chiefly the product of the rich fisheries of the White Sea, to the amount of more than $700,000, and receiving cargoes for Russia of nearly equal value. — (*Deutsch. geogr. bl.*, vi. i., 1883.) W. H. D. [720

(*Asia.*)

Persia. — Stack's 'Six months in Persia' (2 v., New York, *Putnam*, 1882) is an entertaining narrative of an overland journey by one well fitted for it from his knowledge of the language of the country. His descriptions seldom have an especially geographical turn, as most of his route had been fully described before; but one would like to hear more of the burial of the old town of Askizar in drifting sands (ii. 4), of the depth to which the rivers have cut in the alluvial slope at the foot of the mountains, so as to be out of reach for irrigation, and of the ascent of Demavend (ii. 179). The characteristic Persian landscape is desert plains bordered by rugged mountains, with villages along the lower slopes where they can get a supply of water. The accounts of the people's dissatisfaction under Persian misgovernment; of their apparent desire for external control, and their wonder whether it will come from Russia or England, of which they have very indistinct notions; and of the polyglot society in the larger towns, — are all of interest. A chapter is given on the outfit necessary for travelling in comfort; and a number of route-maps illustrate the several parts of the journey from Bushir to Karmán, Ispahan, Tehran, and the Caspian. — W. M. D. [721

Southern Persia. — Persian exploration seems to be attracting much attention in England; and the March number of the Royal geographical society's proceedings is almost entirely occupied with the accounts of recent travellers there, and the discussions their narratives excited. Col. Champain points out the small amount of trade carried on with Persia by British merchants, and shows that Russian wares are superseding British in the Persian markets. This he ascribes to the wretched condition of the roads from the southern coast of the country and in Turkish Arabia, and advocates an attempt to improve them, as well as to build a railroad from Baghdad to Khanakin (100 m.), and to improve the channel of the Karún River where obstructed by rocks at Ahwaz. G. S. Mackenzie, of the house of Gray, Paul, & Co., at Bushir, on the Persian Gulf, described his experience on inland journeys, made some years ago, as far as Ispahan; and, while he considered it too soon to project railroads there, he thought much could be done by improving the rivers and roads. Capt. H. L. Wells gives detailed narrative and surveys of several routes across the mountainous country from Bushir, inland to Ispahan, and from Lake Niris, near Shiraz on the south-east, as far as the Karún River, 300 miles to the north-west. Although far better than the deserts of central Persia, the towns are generally forlorn and dirty, and the roads are very rough. Lake Niris is also quite unlike the flat swamps of the desert regions farther east, as its shore-line is very irregular, its banks are often precipitous, and numerous rocky islands rise from its blue waters. It was found to have a large extension to the east from its north-western end, not previously explored, known as Tasht or Nargis, joining the main lake by a narrow passage. The lake has no outlet, and its waters are bad but drinkable. Ruins and cuneiform inscriptions were found at several points. — W. M. D. [722

Yesso. — This northern Japanese island is described by Dr. Brauns of Halle as even more picturesque than Dai Nippon. Its surface is sharply broken by mountain and valley, and the volcanic peaks and leaping streams give it a most attractive landscape. Volcano Bay, north of Hakodate, with numerous cones rising to six thousand feet around it, is named as one of the most beautiful places in the world. The central part of the island contains a bold and high range of old crystalline rocks, bordered by the heavy miocene lignite formation, and the fossiliferous pliocene strata. The volcanic rocks belong with the latter, and consist of the true eruptive masses (Lyman's 'old volcanic formation') and the later stratified tuffs, which often cover extensive areas. No glacial action is recognized in the quaternary deposits. Brief notes are added on the fauna and flora. — (*Verh. erdk. Berl.*, 1883, 43.) W. M. D. [723

BOTANY.

Cryptogams.

Action of light on Algae. — Berthold has made a minute study of the action of light on seaweeds, especially Florideae, and gives the results of his observations on species growing near Naples, and of his cultures made at the zoölogical station in that city. Under the influence of feeble illumination, the species studied turned towards the light; but, when stronger light was used, they turned from it. He considers, in detail, the effect of light in modifying the growth and branching of different species. Many seaweeds are, at some seasons of the year, covered with colorless hairs, whose function has hitherto been supposed to be connected with absorption of nutritive material. Berthold denies this supposed office of the hairs, and maintains that they act as a protection against too bright light, and states that exposure to light is followed by an increase in the growth of hairs. He also gives an explanation of the iridescence of certain species, which is produced by the formation of small plates on the outer part of the cells, as in Chylocladia, or by globular or irregular bodies in the cells, as in Chondria and Cystoseira. He denies the existence of any true fluorescence in such cases, which he considers to be merely instances of iridescence, and asserts that the plates and globules act as shields against too strong light. He also attributes a similar function to the calcareous incrustation found in Chara and seaweeds like Acetabularia and Corallina. — (*Pringsheim's jahrb.*) W. G. F. [724

Fertilization of red seaweeds. — Professor Fr. Schmitz has published some general observations on red seaweeds, in which he advances the view that the thallus in this group of Algae is always of a filamentous origin, no matter what the cellular character of the mature frond may be, and secondary cell-divisions never include the axis of the primary cells. He considers, in detail, the fertilization and the formation of the carpospores, and is of the opinion that there is no indirect impulse transferred from one cell to another at a distance, even in genera like Dudresnaya and Polyides, but that there is always a direct transfer of cell-contents. The abstract question of the nature of the sexuality in Florideae, as compared with that of other orders, as Ascomycetes and Collemaceae, is treated at length; and he unites the Bangiaceae with Chlorophyceae, rather than with Florideae, as has recently been done by Berthold. — (*Bericht. akad. wiss. Berlin.*) W. G. F. [725

Phenogams.

Influence of sunny and shaded localities on the development of foliage-leaves. — Stahl of Jena has given considerable attention for several years to the effect which light has in the development of the assimilative tissues. It has been held by some that the degree of exposure of a leaf unfolding from the bud can have no influence upon the character of its cells, except so far as etiolation or blanching might produce it. Upon reviewing all the evidence in the light of his recent researches, Stahl thinks that in shaded places the leaves have a less well-marked palisade system, whereas in full sunlight they develop a better palisade system and a less well-characterized spongy parenchyma. The author is convinced that these facts in regard to the partial adaptation of leaves to their surroundings should be borne in mind in the selection of the amount of light in our greenhouses. The paper is well illustrated. — (*Zeitschr. naturwissensch.*, xvi.; N. S., ix. 1, 2.) G. L. G. [726

The largest flower. — Dr. Thurber gives an account of the pollination of Rafflesia, written in an interesting way for young readers. The immense mottled flowers, with an expanse of three feet and a weight of fifteen pounds each, are dioecious. They are fertilized by flesh-flies, attracted by their carrion odor. — (*Amer. agric.*, April.) W. T. [727

ZOÖLOGY.

Coelenterates.

Structure and development of nematophores. — As the result of his study of the nematophores of Aglaophenia, Antennularia, and Plumularia, Merejkowsky concludes that we must abandon the old view that a nematophore is an amoeboid mass of sarcode, since the use of reagents shows that it is made up of distinct nucleated cells. These cells are derived from both layers of the body; the endoderm forming the central axis, and the ectoderm the outer layer. The nematophore is usually divided into two parts, of which one shows no power of motion, and contains a battery of very large lasso-cells; while the second portion is very movable, and exhibits amoeboid changes of form. The active portion is composed entirely of ectoderm, while the immovable portion contains an endodermal axis. The active portion presents a peculiar type of histological structure, since its cells are embedded in and surrounded by a structureless layer of contractile protoplasm, which has in itself the power of active change, and to the contractile power of which the amoeboid movements are due. This protoplasmic layer seems to correspond to that which unites together the cells of labyrinthula; and something similar is found in sponges.

Merejkowsky's investigations of the development of nematophores have led him to believe that these structures are neither organs which have been acquired for a special purpose, nor specialized polymorphic hydranths, but simply degenerated hydranths.

In support of this view, he says, that, when a colony of Plumularia halicioides was kept over night without a supply of running water, the tentacles and oral orifice disappeared, the whole body became reduced in size, and the hydranth thus became converted into something which bore a very close resemblance to a nematophore. The ectoderm gave rise to long pseudopodia, and changed its form continually, exhibiting amoeboid movements which were almost exactly like those of a true nematophore. — (*Arch. zool. exp. gén.*, 1882, 4.) W. K. B. [728

Worms.

Haplobranchus, a new serpulid. — A. G. Bourne describes Haplobranchus aestuarinus, a new species of serpulid, belonging, apparently, to the Sabellidae, but differing from all known forms. A description, including a few anatomical notes, is given. The worm was found on both the Irish and English coasts. — (*Quart. journ. micr. sc.*, 1883, 168.) C. S. M. [729

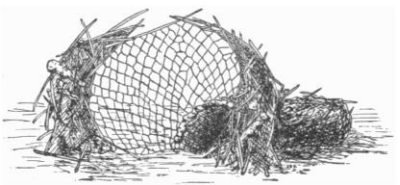
The species of branchiobdella on cray-fish. — Oustroumoff has found a species near Kasan on the gills of Astacus leptodactylus, but which is nearer to B. parasita than to B. astaci, and for which he proposes the name B. astaci leptodactyli. — (*Zool. anz.*, vi. 76.) C. S. M. [730

The teeth and synonymy of Dochmius. — Megnin discusses the synonymy of the genera Dochmius, Strongylus, and Ankylostoma. Dujardin separated Dochmius as toothless forms: but Megnin finds teeth in the Dochmius of the dog; and, believing that they will be found in the other members of the genus, he maintains that the name ought to be re-

placed by Ankylostoma, which has priority for toothed forms of Strongylids. The teeth have been previously overlooked. — (*Bull. soc. zool. France*, 1882, 282.) C. S. M. [73

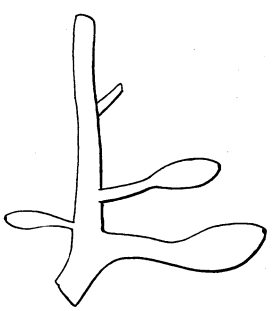
Insects.

Caddis-fly cases. — Miss C. H. Clarke figures and describes two interesting new forms of larval cases of Hydropsychidae from Massachusetts. One of them, that of a Hydropsyche, resembles a tunnel,



loosely attached to a stone by its lower edges, the stone forming the bottom. It may be composed entirely of sand or of vegetable fragments, or of both, and is peculiar for having at its mouth a vertical framework, with a net stretched across it, as in the figure, to catch its prey. The case is built in swiftly running water, and the supporting framework of the net is occasionally stayed by silken cords stretching to suitable points on the stone.

The other, that of a Plectrocnemia, is a tall cyclindrical chimney, with lateral tubes expanding into chambers. The chambers usually end with a small aperture, but sometimes extend into another short piece of cylindrical tube with an aperture at its end. The upper end of the main tube has occasionally two openings, though commonly one. These tubes are found erect in the muddy bottoms of brooks, and, but for the apical opening, look like the twigs one may see stranded in such places. Miss Clarke was unable to discover in which part of the case the larva lived; but the pupa was always found in the upright shaft, its place usually indicated by an enlargement. — (*Proc. Bost. soc. nat. hist.*, xxii. 67.) [732



VERTEBRATES.

Origin of the vertebrate mesoderm. — Romiti discusses His's view, that the mesoderm has a double origin, in part from the primitive streak, and in part from independent cells, which His calls parablastic, and thinks derived from the yolk, and destined to form the connective and vascular tissues. Romiti admits the double origin, but maintains that the independent cells are derived from the germinal portion. The cells in the periphery of the mesoderm are derived "from the proliferation of some large cells which have emigrated from the segmented germ, and lie between the primitive layers." — (*Arch. ital. biol.*, ii. 277.) C. S. M. [733

Formation of serum albumen in gastric digestion. — It is generally believed that proteids, when digested in the stomach or small intestine, are transformed into peptones, and absorbed in that form; but there has always been the objection to this view, that peptone cannot be found (or, if found, then only in minute quantity) in the blood of the portal vein, or in the chyle. Hence, if the proteids eaten were turned into peptone, and absorbed in that form, they must very quickly be converted into the albumens of the blood, lymph, or chyle. Von Ott now claims that he has proved that serum albumen is produced in the stomach and intestines during digestion. But his proof consists, 1°, in assuming that Martius was correct when he stated that no proteid but serum albumen will cause the heart of a frog, which has been brought to a standstill by washing with salt solution, to beat again; and, 2°, in showing, that, from the contents of the stomach or intestine of a digesting animal, a solution can be prepared which will make the heart recommence beating. As numerous intermediate and by-products are known to be formed during the digestion of albumens, and as Martius did not experiment with several of these, it is clearly necessary that the action of each on the heart be studied before we are justified in concluding that a heart which is fed by a liquid containing them is nourished by serum albumen, and not by them or some one of them. Von Ott finds that milk is an excellent food for the frog's heart, but that it loses this power when all proteids are removed from it. — (*Du Bois' archiv*, 1883, 1.) H. N. M. [734

Excitation of vascular nerve-centres by the summation of electrical stimuli. — Kronecker and Nicolaides have examined the influence of successive stimuli upon the vaso-motor system, in order to see if the vascular nerve-centres obey the laws which have been established in this regard for the reflex movements of the limbs. They find a general agreement. Single induction shocks applied to vaso-motor centres in the medulla or spinal cord have no influence upon arterial pressure. Moderately strong stimuli first begin to act by summation when they follow at not greater intervals than half a second. Increasing the rate of stimulation increases the effect up to a rate of from twenty to thirty per second: increase of rate beyond this has no effect. Keeping the rate quite slow and constant, but increasing the intensity of the stimuli, increases the effect, but never so much as quickening the rate. The maximum of blood-pressure can be obtained either with powerful shocks at $\frac{1}{10}$–$\frac{1}{12}''$ intervals, or moderately powerful induction shocks at $\frac{1}{20}$–$\frac{1}{25}''$ intervals. It takes longer to attain the maximum result with slow, powerful stimuli, than with weaker, but more rapid; also with slow stimulation the absolute number which must be given before the maximum result is attained is greater. The conclusion is therefore reached, that the cells of the vascular nerve-centres agree essentially with the proper motor cells of the spinal cord in having an inherent tendency (in the dog) to vibrate at a rate of about twenty times a second. — (*Du Bois' archiv*, 1883, 27.) H. N. M. [735

Tetanic stimulation of frogs' nerves by a constant current. — Von Frey has lately carried on a series of investigations as to why a frog's muscle is sometimes tetanised — though usually only giving a single twitch — when a constant galvanic current is sent through its nerve. He points out some of the conditions under which the long-continued contraction is observed, and shows that it is a true tetanus, and not merely a very prolonged twitch. — (*Du Bois' archiv*, 1883, 43.) H. N. M. [736

Fish.

Spawning-habits of Ceratodus. — Mr. Haswell has stated before the Linnaean society of New South Wales, that Mr. Morton, of the museum, had ascer-

tained that the so-called 'Ceratodus' of Queensland spawns during the months of June, July, and August, in the Burnett River. A slight excavation is made by the fish in the bed of the river, in water about eight to ten feet deep; and the male and female guard the nest till the eggs are hatched. Hope is held out that a supply of fertilized eggs may be procured next season, and the embryology of the type studied. Thus a great gap in our knowledge of the ancient fish-types may be filled up. — (*Nature*, March 15.) T. G. [737

Development of the pike's skull. — An important memoir on the development of the membrane-bones of the pike's skull has been published by Dr. Johannes Walther. The observations were chiefly made on the young, representing two stages of development, — one 11 and the other 22 mm. long. The author recognizes five categories of ossifications; viz., 'hautknochen,' including 'cementknochen,' 'bindegewebsknochen,' and 'perichondralknochen (centrifugal wachsend)'; and 'knorpelknochen,' including 'perichondral (centripedal wachsend)' and 'enchondral.' For his generalizations, we must refer to the memoir itself (*Jena. zeitschr.*, xvi. 59, pl. 3, 4). In this connection, we may also call attention to a monograph on the development of the pike's shoulder-girdle and pectoral-fin, published by Dr. G. Swirski at Dorpat in 1880. — T. G. [738

Isaak Walton, and the river Lea. — An interesting article on the little river Lea, as it is at present, has been published under the above caption by R. B. Croft. A list of the fishes, with notes as to their occurrence (whether abundant or rare), will enable the Waltonian to compare the past and present of the river immortalized by the 'father of angling.' It supplements a paper some time previously published by Mr. Littleboy in the transactions of the Watford natural history society (ii. 113). — (*Trans. Hertf. nat. hist. soc.*, ii. 9.) [739

Mammals.

American sirenians. — The discovery of a new fossil sirenian in South Carolina brings the number of known existing and extinct forms in North America to eight (Cope. *Proc. acad. nat. sc. Philad.*, 1883, 52). The Florida manatee is still extant in that state, and it is probable that the South American manatee may yet be found in Texas. Two extinct forms (Anoplonassa forcipata, from Georgia; and Hemicaulodon effodiens, from New Jersey) have been previously described by Cope. The type of Owen's Prorastomus was from the West Indies. Two other extinct species of manatee, founded upon teeth, and the new generic form, Dioplotherium Manigaulti, all from South Carolina, complete the number. From recent remarks by Mr. W. H. Dall (*Biol. soc. Wash.; meeting* March 30), it would appear certain that Rhytina has not existed on the coast of the Alaskan peninsula since the advent of man, and probably never. It cannot, therefore, be added to the list of American sirenians. — F. W. T. [740

Foetus of a seal. — Camerano, in vol. xxxv. of the Memorie of the academy of Turin, describes the anatomy of a nearly mature foetus of Otaria jubata Forst. Its length, with the hind-limbs extended, was 51 cm.; its structure showed a close affinity with other carnivora. The author gives a description of the thoracic girdle with measurements. It is noteworthy that the scapula and the coracoid apophysis are relatively more developed than in the adult. The comparison of the cranium with that of the adult shows that variations occur here similar to those observed in the gorilla, especially in the proportion between the cranium proper and the facial region. The brain differs in the usual manner from that of the adult. The right ventricle of the heart is shorter than the left: in the adult they are about equal. The same difference with age exists in lions. The coronary vein is very large. From the aortic arch arise only two vessels, — the innominate trunk and the left subclavian, — not three, as in the adult: the young, therefore, resembles in this respect the aquatic carnivora, with which it is probably phylogenetically related. — (*Arch. ital. biol.*, ii. 285.) C. S. M. [741

(*Man.*)

Duration of fecundity in man. — The generally accepted notion that the period of fecundity for the male does not extend beyond the sixtieth year, and for the female the fortieth year, is shown by M. Mignot to be to a certain degree incorrect. He cites numerous cases which show that the period may extend to the seventieth year in the male, and to the fifty-sixth or fifty-eighth in the female. — (*Soc. sc. med. Gannet*, xxxvi. 19.) F. W. T. [742

The intermedius of the carpus in man and other mammals. — Leboucq has re-examined this bone by aid of microscopic sections, with a view of determining its relations to the other bones of the wrist. It first shows itself with distinctness in human embryos, of which the hand has a length of 2 mm., appearing as a cartilaginous nodule inserted between the scaphoid and the first three bones of the drital row. In hands 2.5 mm. long it appears as a polyhedral nodule attached to the scaphoid at one point near the palmar surface, but otherwise free. In hands 4.5 to 5 mm. long the cartilaginous attachment is broader, but the intermedius is still distinguishable. With the growth of the foetus, the boundaries become less and less distinct, and finally disappear. Leboucq, therefore, decides that the intermedius does not disappear by atrophy, but by fusion with the scaphoid. He does not agree with Rosenberg, that the space supposedly left vacant by atrophy of the intermedius is filled with *tissu à vacuoles*, with large nuclei (?) in its walls, but by simple ligamentary fasciculi.

Although having no new facts to contribute, regarding the chimpanzee and gorilla, in which the intermedius disappears in the adult, he believes that it combines with the scaphoid as in man. In the dog and the cat, the intermedius is also as in man, but extends less in the dorselumbar direction. In embryo bats (notably in Vespertilio murinus) the intermedius is distinctly visible. Its presence in marsupials needs further confirmation. In conclusion, Leboucq states his belief that the intermedius is present in the embryos of all pentadactyle mammals. — (*Bull. acad. sc. Belg.*, (3), iv. 220.) F. W. T. [743

ANTHROPOLOGY.

Resources of anthropology. — The student of any branch of human knowledge is always grateful to those who will show him the results of other men's labors. The surgeon-general's office in Washington has undertaken to be the guide of anthropologists in this respect. Under the direction of Dr. J. S. Billings and Dr. Robert Fletcher, aided by a force of accomplished assistants, are issued the Index medicus and the Index-catalogue of the surgeon-general's office. The former is a monthly catalogue of medical literature, classified so as to be most serviceable to the practitioner, as well as to the student of human biology. Through a system of exchanges and purchases, all the creditable medical anthropological journals of the world are promptly received, and their contents indicated through the Index medicus.

The anthropologist will always find useful information under the words bibliography, anatomy, physiology of the brain and nervous system, biology, abnormalities, anthropology, and craniology. The second-named publication appears in quarto volumes, in which every subject upon which any thing contained in the surgeon-general's library has been written is catalogued with conscientious minuteness, and with reference to the ready convenience of the student. Three volumes have already appeared. — O. T. M. [744

(*Old world.*)

Anthropology of Caffraria. — The anthropological documents collected in Caffraria by M. Delegorgue in the years 1838-44 are made the text of a paper by M. Hamy. He begins with a *résumé* of the writings upon Caffraria prior to the travels of M. Delegorgue, commencing with the 25th of December, 1497, when Vasco da Gama named the country of Natal from the Nativity. To those making a study of the tribes so prominent for their bravery in the face of British soldiers, this chapter will be eminently useful. The documents for which we are indebted to M. Delegorgue relate especially to the Amazulus, although other members of the Bantu group and the Bushmen are not overlooked. In the third chapter of his monograph M. Hamy brings together what is known concerning the craniology of the Caffir tribes, with a table of measurements. — (*Nouv. arch. mus. hist. nat. Paris*, 1881.) J. W. P. [745

Corea. — Mr. William Elliot Griffis is the author of a work upon 'Corea, the hermit nation,' just published by Charles Scribner's Sons. The author made good use of his opportunities, while connected with the imperial university of Tokio, to collect all that could be ascertained concerning the exclusive peninsula. Mr. Griffis makes it very clear that Japan received its first impulses to art and civilization through Corea. Around this favored spot have contended a thousand influences for the mastery, — Mongolians, Cossacks, Japanese; Buddhism, Confucianism, ancestral worship, and Christianity; exclusivism and liberalism. From these bloody conflicts the people have suffered untold miseries, and have been kept back in the progressive march of civilization. A great deal of the space in the volume is devoted to the sociology of the Coreans, a subject in which anthropologists will be especially interested. The unsuccessful endeavors to effect commercial treaties with the Coreans are narrated at length, as well as those which met with a more favorable reception in 1882. — J. W. P. [746

Craniology of the Mongoloids. — Dr. Frederik Carel ten Kate, jun., made the craniology of the Mongoloids the subject of an inaugural dissertation at Heidelberg, and L. Schumacher of Berlin has published his researches in a pamphlet of fifty-eight pages. Several pages are devoted to a minute bibliography of the subject, which makes the paper all the more valuable. Fifty-three crania are minutely measured and described, as follows: Chinese, 10; mixed Chinese, 7; Japanese, 5; Berings people, 4; Yukagir, 1; Tunguses, 5; Bureats, 5; Calmuks, 5; Tatars, 4; Yakut, 1; Baschkirs, 2; Lapps, 4. — J. W. P. [747

(*New world.*)

Peruvian stone-quarrying. — A short paper by Boussingault contains some information with regard to the ancient working of stone in Peru, which is of general interest. An old quarry exists in the environs of Quito. In the trachyte and among the refuse was found a chisel which had evidently been used in quarrying. Its surface was scratched and worn, its edge indented, and its head bruised by the blows of the hammer. Its specific gravity was 8.83, or a little more than that of melted copper. A chemical analysis made by Damour showed that it was composed of 95 % of copper, 4½ % of tin, .2 % of lead, .3 % of iron, and traces of silver.

This bronze was not sensibly harder than common copper; and Boussingault suggests that it was owing to the rock possessing less hardness through its 'quarry water,' that it could be worked by such instruments. By the same cause he endeavors to explain the preparation of the granite monuments observed in Peru by La Condamine, adding thereto the skill and dexterity which the Indian race possessed in the use of their bronze tools. Boussingault's conclusions will probably be questioned by many until the strongest proof is given of their correctness.

He calls attention to the fact, that a chisel found in a silver-mine near Cuzco, and carried to Europe by Humboldt, gave, by Vauquelin's analysis, 94 % of copper and 6 % of tin. — (*Comptes rendus*, xcvi. 545.) M. E. W. [748

Chili. — The *Times* printing-house of Philadelphia has published a pamphlet of forty-eight pages upon Chili. Some information is conveyed concerning the forty thousand Indians within her borders. From the alliance of the Spaniards with the Araucanians, known under thirty or forty tribal names, from the Changos of Atacama to the Cuicos of Osorno, have come two million inhabitants, known severally as *huasos* (horsemen) and *rotos* (ragpickers). There are about forty thousand indigenes remote from civilization. The Araucanians proper are divided into three tribes, — Pehuenches, in the pine-groves (pehuen) of the Andes; Llanistas, in the plains (llanos); and the Costinos, in the cordilleras of the coast. A brief history of the founding of Chili is given, commencing with the famous quarrel between Don Diego de Almagro and Don Francisco Pizarro. — J. W. P. [749

Errors in Waldeck's drawings. — Professor Cyrus Thomas, who has studied the Palenqué tablet of the cross with considerable care, expresses the opinion, that the drawing of the inscription on the left slab as given in the plates of Waldeck's 'Palenqué et autres ruines,' edited by Brasseur de Bourbourg, is almost wholly copied from Catherwood's drawing as published in Stephens's Central America.

He bases this opinion upon the demonstrable fact, that a number of errors which can be pointed out in Catherwood's drawing are all faithfully copied in the Waldeck plate.

This applies only to the six columns of the left inscription, and not to the rest of the plate, which he thinks is more correctly rendered by Waldeck, except as to the human figures, than is Catherwood's drawing.

Is this opinion correct? If so, is the original of Waldeck's drawing yet in existence? These are questions we should be glad to have the French archeologist answer. Prof. Thomas is now preparing a paper for the Bureau of ethnology in which he will give more fully his reasons for this opinion. — J. W. P. [750

Indian music. — In every collection of American antiquities will be found gourd rattles, strings of shells, bones, hoofs, and seed-pods, drums, whistles of clay, wood, and bone, and frequently a stringed instrument, or a pan-pipe. These, "for the most part, are capable of nothing but inexplicable dumb shows and noise." Mr. E. A. Barber, however, has given the subject some attention, and has discovered instruments capable of a rude scale, from which the

fourth and the seventh are excluded, to which the name *pentatonic* has been given. The ancient Peruvians had music very difficult to learn, which expressed, with great compass and pathos, the agreeable and disagreeable emotions of their daily lives. Mr. Barber repeats an account, given by Don Fred. Blume, of the wails of a Peruvian woman on hearing the news of the death of a brother. "The announcement came, it seems, unexpectedly, and the explosion was that of a volcano of grief, — terrible jets from time to time; then a quiet interval; and then, again, a great outburst; and so on. . . . Thus I came to understand how their 'operas' originated, and how natural a mode of expression they are." — (*Amer. nat.*, March.) J. W. P. [751

Aztec music. — While arranging the Poinsett and Keating collections of antiquities in the museum of the academy, Mr. H. S. Cresson noticed some Aztec flageolets and whistles, or pitch-pipes of terra-cotta, an investigation of which had yielded some facts which might be of importance to the ethnologist. Most authorities upon the subject have arrived at the conclusion that the musical knowledge of barbarian tribes is confined to the limits of the so-called pentatonic scale, in which the fourth and seventh tones of the scale, as known to us, are wanting. Upon trying the four-holed Aztec flageolets in question, he had found, that, by closing the bell with the little finger, they could be lowered a full tone, and, from the tonic note thus obtained, the octave could be produced, including the fourth and seventh notes as known to us. Five of the flageolets in question were exhibited, — two in the key of C natural, one in the key of B natural, and the other two in F sharp and B flat respectively. The last-named instrument was chosen to produce the fourth and seventh tones, upon which an expert performer on the Boehm flute ran the diatonic and chromatic scales with but little difficulty. The pitch-pipes, or whistles, were next exhibited; and the same performer demonstrated that a full octave could be produced thereon, together with the ninth, eleventh, and twelfth notes, the tenth being missing. The whistle producing this tenth note must have existed, as it is preposterous to suppose that a people capable of manufacturing the instruments in our possession (several of which are duplicated in the collection), which may be played in trio or quartette, were not more thoroughly acquainted with the principles of music than to content themselves with the narrow limits of the pentatonic scale. This is proven by their ability to manufacture instruments capable of producing, not only the fourth and seventh tones of the diatonic scale, but also the entire chromatic scale. — (*Acad. nat. sc. Philad.; meeting* April 3.) [752

EARLY INSTITUTIONS.

New-England towns. — The student of early institutions in America will be interested in the recent 'History of Great Barrington' (Berks County, Mass.), by Charles J. Taylor. The upper township was distributed in forty proprietary rights. James Bowdoin had seven and a half; other persons had six, five, four, two and a half, or one apiece. These rights were fixed by the settling committee at four hundred acres each. Allotments were made accordingly. We are struck by the resemblance between these proprietary rights with equivalents, and the *mansi, cum campis, pratis, pascuis silvis*, in the German colonies of the early and middle ages. The free colonies, like most of our New-England towns, were associations of proprietors, with defined rights in the land; in recognition of which, each man received certain home-lots and arable lots, together with meadow, pasture, and forest lands; the latter being, very often, held in common. Mr. Taylor confines himself strictly to the history of his own town; but this history embraces many interesting facts, and is suggestive in many ways. The words of Burke, 'People will not look forward to posterity who never look backward to their ancestors,' are printed upon the titlepage. — D. W. R. [753

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

PUBLIC AND PRIVATE INSTITUTIONS.

Peabody museum of American archaeology, Cambridge, Mass.

Altar-mounds in Anderson township, Ohio. — Several of the mounds explored the past summer by Dr. Metz and the curator contained 'altars,' or basins, of burnt clay, on two of which there were literally thousands of objects of interest. Two of these altars, each about four feet square, were cut out, and brought to the museum. Among the objects from the altars are numerous ornaments and carvings unlike any thing heretofore found.

One altar contained about two bushels of ornaments made of stone, copper, mica, shells, the canine teeth of bears and other animals, and thousands of pearls. Nearly all of these objects are perforated in various ways for suspension. Several of the copper ornaments are covered with native silver, which had been hammered out into thin sheets, and folded over the copper. Among these are several of the spool-shaped objects (which I now regard as ear-ornaments), a bracelet, and a bead. One small copper pendant seems to have been covered with a thin sheet of gold. This is the first time that native gold has been found in the mounds, and the small amount found here shows that its use was exceptional. The ornaments cut out of mica are very interesting, and embrace many forms. Among them are a grotesque human profile, and the heads of animals, whose features are emphasized by a red color. Many of the copper ornaments are large and of peculiar shape. There are about thirty of the singular spool-shaped earrings made of copper. Three large sheets of mica were also found; and several finely chipped points of obsidian, chalcedony, and chert, were in the mass of materials. Several pendants, cut from a micaceous schist, are of a unique style of work. Three masses of native copper were found on the altar.

But by far the most important things found on this altar were the several masses of meteoric iron and the ornaments made from this metal. One of these is half of a spool-shaped object, or ear-ornament, like those made of copper, with which it was associated. Another of these ear-ornaments is covered with a thin plating of the iron, in the same manner as others were covered with silver. There is also a folded and corrugated band of iron of the same shape, and nearly the same size, as the band of copper found in a mound in Tennessee, and figured in the last report of the museum (fig. 16). Three of the masses of iron have been more or less hammered into bars, as if for the purpose of making some ornament or implement, and

another is apparently in the natural shape in which it was found.

It is worth recapitulating here, that *native* gold, silver, copper, and iron, were all found on the altar of the large mound in this group, and that all were manufactured into ornaments simply by hammering.

On the altar of another mound of the group were several terra-cotta figurines of a character heretofore unknown from the mounds. Unfortunately, these objects, as well as others found on the altars, had been more or less burnt; and many of them appear to have been purposely broken before they were placed on the altars. Many pieces of these images have been united; and enough has already been made out to show their importance in the study of early American art. The peculiar head-dresses, method of wearing the hair, and the large button-like ear-ornaments, shown on these human figures, are of particular interest. The shape of the ear-ornaments leaves no doubt of the character of the spool-shaped objects previously referred to. On the same altar were two remarkable dishes in the form of animals, carved from stone, which have been nearly restored from a large number of small fragments. With these were a serpent cut out of mica, several hundred small quartz pebbles from the river, and nearly three hundred astragali of deer and elk. As but two of these bones could be obtained from a single animal, and as there were but one or two fragments of other bones, there must have been some special and important reason for collecting so large a number of these particular bones. A finely made bracelet of copper, and several other ornaments of copper, a few pearls and shells and other ornaments, were on this altar, with two large masses of native copper, and a mass of unworked meteoric iron. Many fossil shells were found on both altars.

Harvard college observatory, Cambridge, Mass.

Astronomical photographs. — It is proposed to form, at the observatory, a collection of photographs of the heavenly bodies and of their spectra. Original negatives would be particularly valuable. It may happen that some such negatives, having slight imperfections which would limit their value for purposes of engraving, could be spared for a collection, and would be as important, considered as astronomical observations, as others photographically more perfect. In some cases, astronomers may be willing to deposit negatives taken for a special purpose, and no longer required for study, in a collection where they would retain a permanent value as parts of an historical series. Where photography is regularly employed in a continuous series of observations, it is obvious that specimen negatives only can be spared for a collection; but in such cases it is hoped that some duplicates may be available, and that occasional negatives may hereafter be taken for the purpose of being added to the collection, to exhibit recent improvements or striking phenomena. When negatives cannot be furnished, glass positives, taken, if possible, by direct printing, would be very useful. If these, also, are not procurable, photographic prints or engravings would be desirable.

The observatory already possesses many of the early and historically important specimens which would naturally form part of such a series. Among these may be mentioned four series of daguerrotypes and photographs of various celestial objects, taken at this observatory. These series were respectively undertaken in 1850, 1857, 1869, and 1882.

Copies of memoirs or communications relating to the specimens sent, or to the general subject of astronomical photography, would form an interesting supplement to the collection. A part of the contemplated scheme will involve the preparation of a complete bibliography of the subject, including a list of unpublished photographs not hitherto mentioned in works to which reference may be made.

The expense which may be incurred by contributors to the collection in the preparation and transmission of specimens will be gladly repaid by the observatory, when desired.

NOTES AND NEWS.

— The titles of the papers read during the recent session of the National academy of sciences at Washington, April 17 to 20, were: Joseph LeConte, On the genesis of metalliferous veins (read by T. Sterry Hunt); Elias Loomis, On barometric gradients (read by Cleveland Abbe); Ira Remsen, On the nascent state of oxygen; E. D. Cope, On the structure of the skull in the Hadrosauridae; G. W. Hill, Determination of the inequalities of the moon's motion which are produced by the figure of the earth (a supplement to Delauny's 'Theorie du mouvement de la lune'); T. Sterry Hunt, The decay of rocks geologically considered; S. Weir Mitchell and E. T. Reichert, On the composition of the venom of serpents; Ira Remsen, On changes in the properties of atoms and atomic groups caused by changes in the position in a molecule: W. Ferrel, Maxima and minima tide-predicting machine; S. P. Langley, On the measurement of wave-lengths of heat; Otto von Struve, On the great object-glass made by Alvan Clark and Sons for the Pulkova observatory; S. P. Langley, On the spectrum of an argand gas-burner; G. F. Barker, Efficiency of storage-batteries; C. H. F. Peters, Photographs of the great comet of 1882; H. A. Rowland, Progress in spectrum photography; A. W. Wright, Some experiments upon a method of forming a visible image of the solar corona; A. W. Wright, On the phosphorescence of sulphate of quinine; Wolcott Gibbs, Further generalizations regarding complex inorganic acids; A. Agassiz, The fauna of the Gulf of Mexico.

The autumn session of the academy, for the reading of scientific papers, will be held at New Haven in November.

— Special reports Nos. 56 and 57 of the U. S. department of agriculture for February and March, 1883, are entirely occupied with statistics. No. 56 opens with a report upon the numbers and values of farm-animals in the several states and territories, including a comparison with the corresponding statistics of last year. These show that there has been a decided increase in the number, and in the average price per head, of these animals. The statistics of the cotton-crop point to a probable total movement of not less than 7,000,000 bales, of unusually good quality; making the total crop nearly four per cent larger than the great crop of 1880. The report contains, also, a comparison of the prices of English and American agricultural implements, an article on

transportation-rates in Europe, and a list of transportation-rates on the more important rail and water routes from the west to the seaboard. All these are obviously of more or less general interest; but it is difficult to see how it can be considered the duty of the department to publish, as it does in this report, a gratuitous advertisement of one particular western railroad, avowedly furnished by its western passenger-agent. Report No. 57 is on the distribution of the corn and wheat crops of 1882, and the comparative quantity still remaining on the farm. Statistics are also presented regarding the extent and character of the domestic uses of these crops, and tables of transportation-rates are appended to the report.

— The U. S. geological survey has commenced the publication of octavo bulletins to receive such papers, relating to the general purpose of its work, as would not properly come under the heads of annual reports or monographs. Each paper will be issued separately with a distinct number, and will have two paginations, — one proper to itself, at the top; and one belonging to the volume, at the bottom, — a most convenient arrangement. The first number, just issued, contains a paper by Whitman Cross on hypersthene-andesite, and on triclinic pyroxene in augitic rocks, with a geological sketch, by S. F. Emmons, of Buffalo Peaks, Col., where the principal rocks examined were found. Mr. Cross urges the need of a re-classification of the andesite rocks, and concludes that the chief subdivision of the augite-andesites may much more properly be called hypersthene-andesite Two plates accompany the bulletin.

— At its two hundred and thirty-third meeting, held April 7, the Philosophical society of Washington listened to Prof. W. C. Kerr, on the Geology of Cape Hatteras and the adjoining coasts; to Mr. H. F. Walling, on Topographical indications of a fault near Harper's Ferry; and to Mr. S. F. Emmons, on Ore deposition by replacement.

— At the annual meeting of the Cincinnati society of natural history, April 3, the following officers were elected: president, Dr. J. H. Hunt; vice-presidents, Professors John Mickleborough and George W. Harper; secretary, Davis L. James; treasurer, S. E. Wright; librarian, A. E. Heighway, jun. The report of the treasurer showed a balance in the treasury. The membership dues paid during the year amounted to a larger sum than in any previous year. Reports of the curators and custodian were handed in. The latter stated that the use of the museum by instructors of the high schools and academies was increasing yearly. The collections had been increased largely by donation and purchase, and were as well displayed as the limited space permitted.

— By the consent of the surgeon-general of the army, the Washington anthropological society held its last meeting in the army medical museum. Three papers were read, as follows: Myths of the Dhegiha, the stock including Omahas, Poncas, and Osages, by the Rev. J. Owen Dorsey; A year in anthropology, being a summary of works on man, which appeared in 1882, including those by Americans, those on America, and those of general anthropological interest, by Professor Otis T. Mason; A letter from Sir Rawson Rawson upon the relativity of stature to latitude, derived from the volumes of anthropometry published by the provost-marshal-general's bureau during the war of the rebellion, by Dr. Robert Fletcher.

— Prof. C. H. Hitchcock has just returned home from a tour to the Hawaiian Islands, having visited Kilauea, Mauna Loa, the source of the Hilo flow of 1881, and Haleakala. Kilauea has rarely been filled up with lava so much as at present, the 'black ledge' being covered by over fifty feet thickness of recently cooled lava.

— Mr. Frederick W. True has been appointed acting assistant director of the National museum, to serve during the absence of assistant director, Mr. Goode, who sailed, March 31, for London, to attend the Fisheries exhibition as U. S. commissioner.

— The Society of American taxidermists will hold their third exhibition in New York, May 1 to 5. The programme of the general meeting to be held May 1, at Lyric Hall, is: President Lucas, The scope and needs of taxidermy; William T. Hornaday, Common faults in the mounting of quadrupeds; Prof. F. W. Staebner, Taxidermic value of animal illustrations; President Lucas, On the mounting of crustaceans; F. S. Webster, Taxidermy as a decorative art; F. S. Webster, How to clean bird-skins of all kinds; Samuel F. Rathbun, How to make good bird-skins; Frederic A. Lucas, New method of skinning turtles; William T. Hornaday, Mounting mammal heads.

RECENT BOOKS AND PAMPHLETS.

Partsch, J. Die gletscher der vorzeit in den Karpathen und den mittelgebirgen Deutschlands nach fremden und eigenen beobachtungen dargestellt. Breslau, 1882. 209 p., 4 kart. 4°.

Plumandon, J. R. Le baromètre appliqué à la prévision du temps dans la France centrale. Paris, 1883. 15 pl. 12°.

Renault, B. Cours de botanique fossile, fait au Muséum d'histoire naturelle. Troisième année. Fougères. Paris, *Masson*, 1882. 36 pl. 8°.

Rütimeyer, L. Die Bretagne. Schilderungen aus natur und volk. Basel, 1883. 8°.

Saporta, le marquis de. Apropos des algues fossiles. Paris, *Masson*, 1882. 10 pl. 4°.

Scheffler, H. Die magischen figuren. Allgemeine lösung und erweiterung eines aus dem alterthume stammenden problems. Leipzig, 1882. 114 p., 2 pl. 8°.

Scheiner, Jul. Untersuchungen über den lichtwechsel Algols nach den Mannheimer beobachtungen v. Prof. Schönfeld in den jahren 1869 bis 1875. Inaugural-dissertation. Bonn, 1882. 31 p. 8°.

Schmid, A. E. v. Leitfaden für den unterricht in ausgewählten kapiteln der chemischen technologie. Zum gebrauch an handels-, industrie- und gewerbeschulen. Graz. 330 p. 8°.

Schmitz, F. Die chromatophoren der Algen. Vergleichende untersuchungen über bau und entwickelung der chlorophyllkörper und der analogen farbstoffkörper der Algen. Bonn, 1882. 184 p., 1 pl. 8°.

Schultz, G. Die chemie des steinkohlentheers mit besonderer berücksichtigung der künstlichen organischen farbstoffe. Braunschweig, 1882. 1106 p., illustr. 8°.